



**Quality Assurance Program Plan
for the
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation**

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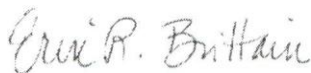
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EPA Project Manager

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ACRONYMS AND DEFINITIONS

BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAGD	West Virginia Corrective Action Guidance Document
CLP	Contract Laboratory Program
CSM	Conceptual Site Model
DLR	Division of Land Restoration
DOT	Department of Transportation
DQO	Date Quality Objective
DRO	Diesel Range Organics
DWWM	Division of Water and Waste Management
EDD	Electronic Data Deliverables
EOI	Expression of Interest
EPA	U.S. Environmental Protection Agency
ERIS	Environmental Resource Information System
GRO	Gasoline Range Organics
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IATA	International Air Transport Association
IDW	Investigation Derived Waste
LRS	Licensed Remediation Specialist
LUST	Leaking Underground Storage Tank
MDL	Method Detection Limit

MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTBE	Methyl Tertiary Butyl Ether
OER	Office of Environmental Remediation
ORO	Oil Range Organics
PAH	Polycyclic Aromatic Hydrocarbons
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PCBs	Polychlorinated Biphenyls
PPE	Personal Protective Equipment
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manager
QAP	Quality Assurance Plan
QAPP	Quality Assurance Program Plan
QAT	Quality Assurance Team
% R	Percent Recovery
RFQ	Request for Quotes
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SOP	Standard Operation Procedure
SVOC	Semi-Volatile Organic Compound
SW-846	Refers to the EPA publication entitled Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

TAGIS	Technical Applications and Geographic Information System
TBA	Tertiary Butyl Alcohol
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
UECA	Uniform Environmental Covenant Act
VOC	Volatile Organic Compound
VRP	Voluntary Remediation Program
VRRA	Voluntary Remediation and Redevelopment Act
WVDEP	West Virginia Department of Environmental Protection

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1.0 INTRODUCTION

This Quality Assurance Program Plan (QAPP) is intended for use by the West Virginia Department of Environmental Protection (WVDEP), Division of Land Restoration (DLR), Office of Environmental Remediation (OER). The Office of Environmental Remediation administers multiple cleanup programs, including the Brownfields Program, Leaking Underground Storage Tank (LUST) Program, Uniform Environmental Covenant Act (UECA) Program, and Voluntary Remediation Program (VRP). The relevant statutes for these programs are the Underground Storage Tank Act (WV Code Chapter 22 Article 17), Uniform Environmental Covenant Act (WV Code Chapter 22 Article 22B), and Voluntary Remediation and Redevelopment Act (WV Code Chapter 22 Article 22), and the rules promulgated to enforce each act. The primary beneficiaries of this plan will be the project management staff and emergency response staff; however, other programs will be aided and protected by the consistency and quality assured by this plan. At a minimum, the QAPP will be reviewed and updated, as necessary, every five years.

1.1 LUST Program

The LUST Program provides oversight of the cleanup of releases of regulated substances (primarily petroleum products) from leaking underground storage tanks and piping, overfills, and spills. Owners and operators of regulated UST systems may choose to clean up releases by following the traditional standard enforcement path, seeking closure under the Uniform Environmental Covenant Act (UECA), or applying to the Voluntary Remediation Program. The traditional approach utilizes specific numerical standards for soil and groundwater cleanup levels as defined in the West Virginia Corrective Action Guidance Document (CAGD). The LUST Program also administers the federal and state LUST Response Funds that are used for state-lead investigations and cleanups, when the state takes the lead at sites where an emergency exists; the responsible party does not have the financial means to respond to the release; or in those circumstances where the responsible party refuses to comply with the requirements. Data is collected under this program to delineate the extent of contamination from LUST sites and to formulate corrective action plans, which result in the subsequent closure of the sites once numerical clean-up standards have been reached. The UECA and VRP pathways utilize risk-based standards in order to reach closure.

1.2 Uniform Environmental Covenant Act Program

The Uniform Environment Covenant Act (UECA) was enacted by the West Virginia (WV) Legislature as a means for encouraging the voluntary cleanup of contaminated sites and

redevelopment of abandoned and/or under-utilized properties. The UECA Program utilizes risk-based remediation standards as outlined in the Voluntary Remediation Program Guidance Manual. Data is collected under the program to delineate the extent of contamination from sites and to formulate remedial actions utilizing risk based standards.

In the LUST-UECA pathway to closure for LUST sites, responsible parties may choose to remediate the site to risk-based standards for only the contaminants associated with the petroleum release by entering into a LUST-UECA agreement with the agency. Upon achievement of remediation standards, the responsible party will receive a "No Further Action at this time" which amounts to a closure of the leak case similar to what is achieved by following the traditional path; however, the closure will also require an environmental covenant with restrictions to be recorded to appropriately control the risks/exposures to achieve the remediation standards.

1.3 Voluntary Remediation Program

The Voluntary Remediation and Redevelopment Act (VRRRA) was enacted by the WV Legislature for the purpose of encouraging the voluntary cleanup of contaminated sites and redevelopment of abandoned and under-utilized properties. The VRRRA encourages voluntary remediation and redevelopment through an administrative program set out in the WV Code of State Rules (CSR) Title 60, Series 3 entitled the "Voluntary Remediation and Redevelopment Rule" (the Rule), which became effective on July 1, 1997. A "brownfield applicant" is a special case of voluntary remediation. While brownfield sites are industrial or commercial properties that are abandoned or inactive, under the VRRRA a "brownfield applicant" involves the use of public funds for the site assessment or remediation. Because of the use of public funds, a much higher degree of public involvement is required for "brownfield applicant" cleanups. The VRP utilizes risk-based remediation standards as outlined in the Voluntary Remediation Program Guidance Manual. Data is collected under the VRP to delineate the extent of contamination from sites and to formulate remedial actions utilizing risk-based standards.

2.0 PROGRAM MANAGEMENT

2.1 Program Organization and Responsibility

The organizational chart provided in Figure 1 identifies the individuals responsible for the following positions and provides sufficient evidence of the lines of authority for all referenced organizations that are appropriate to accomplish the quality assurance (QA) objectives of OER. Certain individuals may be responsible for more than one function. In 2014, WVDEP implemented an enterprise-based model to ensure the agency is effectively working to ensure quality is established in all business conducted. This enterprise model brings together all levels of the agency to efficiently address quality issues. The enterprise levels include the Quality Assurance Team (QAT), the Steering Committee, and the Executive Committee.

The WVDEP Cabinet Secretary has delegated the day-to-day responsibility of overseeing quality control to the QAT. This team works to address quality issues through regular meetings as well as through workgroups formed when needed to address specific issues and provide recommendations for solutions. In addition to the chairperson—an environmental analyst with the Business and Technology Office (BTO)—the QAT also consists of the chief and deputy chief of BTO and representatives from each division and office.

The role of the Steering Committee is to assure that projects and activities are prioritized based on WVDEP's vision, goals, and objectives. The members of the Steering Committee include the chief of BTO (who serves as committee chair), the assistant chief of BTO for Integrated Regulatory Information Support (IRIS), and one or more appointed representatives from each division/office of WVDEP. The WVDEP internal auditor serves as an advisor to the QAT and the Steering Committee.

The next component of the quality model within WVDEP is the Executive Committee. This committee establishes agency-wide goals and objectives from which project plans are prioritized; resolves disputes; and approves projects and activities that are escalated from the Steering Committee. The members of the Executive Committee include the Cabinet Secretary, Deputy Cabinet Secretary, general counsel, division directors, and office chiefs.

2.1.1 DLR Director/OER Assistant Director/OER Program Manager

The DLR Director and two assistant directors oversee two offices under the Division of Land Restoration. One assistant director oversees the Office of Environmental Remediation, and the other assistant director oversees Office of Special Reclamation. The DLR Director and OER Assistant Director are responsible for the administration of all facets of the multiple cleanup programs conducted under the Office of Environmental Remediation, which include the Brownfields Program, Landfill Closure Assistance Program, Leaking Aboveground Storage Tank Program, Leaking Underground Storage Tank Program, Pollution Prevention and Open Dump Program, RCRA Corrective Action Program, Superfund Program, and Voluntary Remediation Program. The OER Program Manager oversees the daily operations of the Brownfields, LUST, and Voluntary Remediation Programs and supervises the OER Project Managers.

2.1.2 OER Project Managers

OER Project Managers perform various functions associated with the projects that they manage. Depending upon the program managed and the specific situation for a given site, an OER Project Manager may perform duties including, but not limited to: prioritizing sites, obtaining rights-of-entry, sampling, selecting laboratories for sample analysis, selecting and managing contractors, overseeing remedial actions at sites, and implementing the QAPP. In addition, OER Project Managers are responsible for review and approval of all data and documents generated at the sites they manage.

2.1.3 Contract Specialist

The contract specialist has overall fiscal responsibility for the programs administered under OER. The contract specialist selects consultants and/or contractors to perform environmental site assessments and other environmental work. The selection is made by using a Best Value Procurement tool such as Expression of Interests (EOIs) for selection of architectural and engineering services. Work also involves purchasing equipment, material, and other supplies for OER by using the competitive bidding process such as Request for Quotes (RFQs) and ensuring that contracts are in place with laboratories and other vendors and are updated as needed.

2.1.4 OER Quality Assurance Manager

The OER Quality Assurance Manager (QAM) has direct responsibility for assessing quality assurance/quality control (QA/QC) performance; determining if QA/QC objectives are being met; recommending corrective actions; and keeping OER Project Managers informed of relevant QA/QC information. The QAM is independent of the data generators (i.e. laboratories and contractors); however, the QAM may have some duties that result in the generation of data. In accordance with Section 2.3 of the WVDEP Quality Management Plan, when a situation arises where there may be a conflict of interest between the QAM in a division and the review of that division's activities, the WVDEP Quality Assurance Team will be called upon to review the circumstance as it pertains to quality assurance. All issues and decisions regarding the Quality Assurance Program Plan should be made by the OER QAM in consultation with the OER project management staff, WVDEP QAT, and Environmental Protection Agency (EPA) Region III, as appropriate.

2.1.5 WVDEP Laboratory Quality Assurance Program

WVDEP's Division of Water and Waste Management (DWWM) Laboratory Quality Assurance Program is responsible for certifying environmental laboratories in order to ensure that all divisions of WVDEP receive accurate and reliable analytical data. Laboratories are certified when they follow approved methods, employ well-trained capable staff, and use equipment and instrumentation suited to the work they perform. A laboratory's certification may be revoked if the laboratory commits any falsification relating to certification, testing, or reporting of analytical results or for failing to meet the proficiency testing requirements. DWWM Laboratory Quality Assurance Program personnel provide laboratory certification services to all divisions of WVDEP. In addition, the certification program is open to any U.S. laboratory seeking to provide data to WVDEP.

2.1.6 Licensed Remediation Specialists

Under the Voluntary Remediation and Redevelopment Act, Licensed Remediation Specialists (LRS) are required to supervise activities during cleanups pursuant to the Act. The applicant entering the Voluntary Remediation Program selects an LRS of their choice, but the LRS must meet certain minimum requirements as set out in VRRRA. All candidates for licensing must meet minimum education requirements; document experience in remediation; and demonstrate practical knowledge about environmental regulations, site investigations, health and safety

protocol, quality assurance, and remedial design. This practical knowledge must be demonstrated by passing an examination given by WVDEP.

2.1.7 Contractors, Subcontractors, and Consultants

In general, responsible parties being regulated hire contractors and consultants to perform environmental assessment and remediation work; however, there are instances when OER finds it necessary to hire contractors and consultants to perform the necessary work. OER follows state established practices when hiring contractors/consultants. In general, contractors/consultants are selected based upon their qualifications through the Expression of Interest process, and then costs are negotiated. Contractors/consultants may be hired by OER to perform a wide range of services such as, but not limited to: completing site investigations, executing simple sampling events, performing laboratory analysis, removing underground storage tanks, disposing waste, and designing/installing remediation systems.

Depending upon the scope of work to be performed, a contractor may hire subcontractors to perform work for them. The contractors are responsible for the selection of subcontractors and, in cases where the contractor was hired by OER, OER must grant approval for the use of the subcontractor. It is the responsibility of the primary contractor to train the subcontractors and to ensure their compliance with the provisions of the QAPP and all other project related plans.

The contractor and any subcontractors are required to be clearly identified in site-specific plans generated for OER projects. The main contractor's site project manager will be responsible for maintaining communications with the OER Project Manager. Communication procedures between the contractor's personnel, subcontractors, and OER shall be addressed in the site-specific Sampling and Analysis Plan (SAP). The contractor's site Project Manager will be required to notify the OER Project Manager in advance (one-week minimum) of all field activities so that the OER Project Manager may perform oversight procedures in accordance with Section 4.1.1 of this QAPP.

2.1.8 Data Reviewers/Data Validators

Personnel at the WVDEP Certified Laboratory performing the sample analyses generally perform laboratory data review. The contractor/consultant, LRS, and/or OER Project Manager may also perform data review activities to determine whether the data is of acceptable quality.

Data validation includes assessment of the whole raw data package from the laboratory. It requires that the techniques utilized be applied to the body of the data in a systematic and uniform manner. Standard EPA protocols for validation (e.g. Contract Laboratory Program (CLP) protocol) should be used. For data validation purposes, the analytical laboratory should be required to generate documentation equivalent to a full CLP deliverables package for the Voluntary Remediation Program. With respect to samples collected for the LUST Program (traditional pathway) or samples collected for waste characterization purposes, documentation equivalent to a full CLP deliverable package is generally not warranted, unless the responsible party intends to bring the LUST site into the VRP or will seek closure under the LUST-UECA

Program. Consultants, contractors, or subcontractors may perform third party data validation as long as the data validator is not affiliated in any way with the analytical laboratory that produced the data. Furthermore, the data validator cannot have been involved in the collection of data for the project. A data validator should be a person who is knowledgeable of chemistry and has an understanding of analytical methods and laboratory instrumentation. A degree in chemistry or a related physical science with training in laboratory instrumentation, analytical procedures, and general laboratory operations is appropriate and recommended. Refer to Section 5.2 for a discussion of data validation requirements.

2.2 Program Strategy

Quality assurance is a system of management activities that involves planning, implementation, assessment, reporting, and quality improvement. OER strives to ensure that the information collected for environmental projects (whether collected by OER Project Managers or contractors) will OER project management staff to make informed, defensible decisions.

The purpose of the Quality Assurance Program Plan is to serve as a guidance document describing how OER will identify the type and quality of the environmental data needed for the various programs that the office administers. OER will utilize the Data Quality Objectives (DQOs) Process to identify the type and quality of environmental data needed for our projects. DQOs are qualitative and quantitative statements that allow the user to:

- clarify the intended use of the data to be collected,
- define the type of data needed to support the decision,
- identify the conditions under which the required data should be collected, and
- specify the acceptable limits on the probability of making a decision error based on the uncertainty in the data.

The seven steps of the DQO Process are used during the planning of projects to ensure that field activities, data collection operations, and the resulting data meet project objectives. A summary of the DQO Process is provided below:

Step 1 – State the Problem: *Summarize the project concisely, reviewing prior studies and existing information.*

Step 2 – Identify the Decision: *Determine the available options under consideration and identify the decision(s) that need to be made based on the environmental data collected.*

Step 3 – Identify Inputs to the Decision: *Identify the information that is needed to make informed, defensible decision(s).*

Step 4 – Define the Boundaries of the Study: *Define the time periods and area of study, including when and where the data will be collected, and identify any budgetary constraints of the project.*

Step 5 – Develop a Decision Rule: *Define the specific action levels and parameters of interest and integrate with the previous DQO outputs to describe a logical basis for choosing an appropriate action based on the results.*

Step 6 – Specify Limits on Decision Errors: *Determine an estimate of how much uncertainty in the data is acceptable. The acceptable decision error rate will be based on the possible consequences of making an incorrect decision.*

Step 7 – Optimize the Design for Obtaining Data: *Evaluate the information from the previous steps to generate alternative data collection designs to meet and satisfy the DQOs in the most efficient and cost-effective manner while ensuring that the resulting data meets the project objectives.*

2.3 Quality Objectives and Criteria for Measurement Data

DQOs are qualitative and quantitative statements, which specify the quality of environmental monitoring data required to support decisions. DQOs are predicated in accordance with the anticipated end uses of the data being collected. DQOs are applicable to phases and aspects of the data collection process including site investigation, design, construction, and remedy operations. It is important to note that the level of detail and data quality may vary with the intended use of the data. Prior to all environmental measurement activities, site-specific DQOs and measurement performance criteria will be determined. All measurements will be made so that results are reflective of the medium and conditions being measured. QA/QC samples generally applicable to OER's programs include the collection of field duplicate samples, splits, equipment rinsate, and trip blanks. At the discretion of WVDEP, the collection of split samples may also be performed at a frequency of 10%. In the context of quality control (QC), samples such as duplicates, splits, equipment rinsate, and trip blanks are utilized to aid in the evaluation of measurement error. The data validation report provided for any given project should evaluate all QC elements, including data from these samples. The data validation level shall be matched to the intended use of the data and may differ with specific projects as described in the project-specific Sampling and Analysis Plan. Where sample results are being used for risk-based evaluations conducted utilizing brownfield grant moneys for assessments in support of redevelopment of brownfield sites, 100% of the analytical data should be validated. The minimum acceptable level of data validation for risk based closure is validation to Stage 4 level. Refer to Section 5.2 for a discussion of data validation requirements.

The DQO Process will be used by OER in data collection activities; however, a graded approach will be used when performing the following activities:

- Emergency response activities where timely decisions must be made to protect public health or the environment

- Compliance or enforcement activities where waste constituent knowledge must be obtained on short notice or in circumstances where safety or time is of the essence

In situations where an imminent threat to public health and/or the environment exists, the seven steps of the DQO process may be modified, as necessary, to ensure that useable data is acquired while not impeding the agency's response in protecting public health or the environment. The modifications to the DQO process may include, but are not limited, to the following:

- The DQO process may be less formal (verbally outlined as opposed to written), at least initially to allow quick implementation of activities as needed.
- The DQO process may not require higher levels of validation due to the need for quick turnarounds.
- Meeting the action levels described in Section 2.4 of this QAPP may not initially be a concern if there is an immediate public safety and health threat.
- An initial response may not include all boundaries of a study area, but may be limited initially to potential areas affecting public safety and health.
- Budgetary constraints may or may not be considered in emergencies.
- The amount of decision error initially accepted may be higher than normally accepted for environmental issues if it is protective of the public safety and health.
- The optimization of the data collection design in order to obtain data in the most efficient and cost effective manner may not be an issue when dealing with emergencies and other public safety issues.

Data collected by OER will be used to:

- Identify the nature and extent of the contamination
- Determine treatment and disposal options
- Characterize soil and groundwater for on-site or off-site treatment
- Collect data to perform risk assessments
- Review data presented in risk assessments
- Collect data to formulate remediation strategies
- Review and approve the use of remedial strategies
- Evaluate the effectiveness of remedial actions
- Verify attainment of clean-up goals or determine if additional remediation is required

Data Quality Objectives are typically assessed by evaluating Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity (PARCCS) of all aspects of the data collection process. PARCCS is defined as:

Precision: This is a measure of the degree of reproducibility of an analytical value, and it is used as a check of the quality of the sampling and analytical procedures. Precision is determined by analyzing replicate samples. QC samples (duplicate samples) may be collected in the field for a project in order to show precision.

Accuracy: This is the degree to which a measurement agrees with the actual value. The accuracy of an analytical procedure is determined by addition of a known amount of spike standard to a field sample matrix or a laboratory control matrix.

Representativeness: Representativeness expresses the degree to which sample data accurately and precisely represents actual conditions. It is a qualitative determination. The representativeness objective when developing the sampling plan is to eliminate conditions that may result in non-representative data being collected. Maintaining sample integrity is of the utmost importance.

Completeness: Completeness is a measure of the amount of the data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The minimum level of completeness expected is 95% for each analytical method requested. This level is met in the laboratory by ensuring property sample extraction procedures. This level is met in the field by collecting enough sample that the laboratory has an ample amount in case they need to reanalyze the sample.

Comparability: Comparability is the confidence with which one data set can be compared with another. When traceable standards and standard methodology are used, the analytical results can be compared to other laboratories with similar operating procedures. QA samples (split samples sent to a second laboratory) are sometimes collected to show comparability.

Sensitivity: Sensitivity is defined by the method detection limits (MDLs). The achievement of MDLs depends upon the instrument sensitivity to ensure data quality through ongoing checks on instrument performance. The MDL is defined as the minimum concentration that can be measured with 99% confidence that the concentration is above zero. Unless otherwise specified in the project-specific work

plans, the analytical results are compared against the laboratory MDLs.

To assess if environmental monitoring measurements are of an appropriate quality, the general PARCCS requirements found in Section 5.3 of this document for precision, accuracy, and completeness will be compared to the site-specific quality objectives and measurement performance criteria.

2.4 Action Levels

In order to determine if there is a potential risk to human health and/or the environment at a site, the contaminants known to be present or potentially present at a site will be assessed. Refer to Appendix A for a typical list of the chemicals of concern and their associated action levels for LUST sites and the De Minimis levels for the Voluntary Remediation Program (Table 60-3B), updated June 2014. Contaminant concentrations focusing on human health will be compared to the following action levels by media:

<u>Soil:</u>	Current LUST guidelines as defined in the <i>Corrective Action Guidance Document (CAGD)</i> Current guidelines as defined in Table 60-3B of WV CSR Title 60, Series 3, <i>The Voluntary Remediation and Redevelopment Rule</i>
<u>Groundwater:</u>	Current guidelines as defined in WV CSR Title 47, Series 12, <i>The Requirements Governing Groundwater Standards</i> Current guidelines as defined in Table 60-3B of the West Virginia CSR Title 60, Series 3, <i>The Voluntary Remediation and Redevelopment Rule</i>
<u>Surface Water:</u>	WV CSR Title 47, Series 2, <i>Requirements Governing Water Quality Standards</i> Current EPA National Recommended Water Quality Criteria
<u>Sediment:</u>	Current guidelines for the development of Uniform Risk-Based Standards for Surface Soils/Sediments as defined in WV CSR Title 60, Series 3, <i>The Voluntary Remediation and Redevelopment Rule</i>

For ecological receptors, surface water standards (WV CSR 47, Series 2) will be utilized as action levels. Also, the guidelines by *USEPA Region III Biological Technical Assistance Group (BTAG)* for surface water and sediments may be utilized as screening level values, where applicable. Refer to <https://www.epa.gov/risk/biological-technical-assistance-group-btag-screening-values> for the guidelines. With regard to soil benchmarks, there are several potential databases that may be applicable, depending on which receptors are relevant. Separate screening values for wildlife, terrestrial plants, and soil invertebrates are available from the U. S.

Department of Energy, Oak Ridge National Laboratories at:
http://www.esd.ornl.gov/programs/ecorisk/benchmark_reports.html.

2.5 Special Training/Certification

2.5.1 OER Personnel and On-site Contractors

Specialized training or certification requirements may be necessary for performing work at a given project location. As appropriate, OER personnel and contractors performing work at project locations will have specialized training. Specialized training/certification may include, but is not limited to, the following:

- Monitoring well driller certification
- Underground storage tank training/certification
- Licensed Remediation Specialist certification
- Safety training such as Hazardous Waste Operations and Emergency Response (HAZWOPER) training
- Department of Transportation (DOT) training if waste materials are to be moved off-site
- Groundwater modeling and soil leaching modeling training
- Risk assessment training
- Training for various remedial systems
- Training for non-routine field sampling techniques or field screening methods

On-site contractors are responsible for providing any specialized training and/or certification for their personnel. Furthermore, they are responsible for assuring that all required training and/or certification requirements are met and documented.

In accordance with Section 4.1.1 of the WVDEP Quality Management Plan, WVDEP managers are responsible for ensuring that each staff member involved with collecting environmental data has the necessary technical, quality assurance, and project management training and certifications or documentation required for their assigned tasks and functions. Managers are also responsible for ensuring that technical staff maintains the necessary level of proficiency to effectively meet QA responsibilities. QA training and additional development needs will be identified as part of regular performance discussions.

Maintaining staff proficiency is the joint responsibility of the individuals filling those positions and their managers. Program and/or project managers shall have a working knowledge, through appropriate training, of the WV DEP planning process (i.e., DQO process) and the EPA QAPP requirements. The division directors oversee assistant directors and/or program managers who are responsible for arranging, providing and documenting the proper training of personnel.

2.5.2 Analytical Laboratory Personnel

All analytical work for OER programs must be performed by a WVDEP Certified Laboratory. Laboratory certification is conducted in accordance with the requirements of WV CSR Title 47, Series 32, *Environmental Laboratories Certification and Standards of Performance*. A copy of WV CSR Title 47, Series 32 is located in Appendix C of this plan. Education and experience requirements for laboratory supervisors are found in Table 2 of this regulation. The Quality Assurance Program Plans of the contracted laboratories have been approved by WVDEP. During this review/approval process, WVDEP verifies that the laboratory's personnel, facilities, sample handling procedures, equipment, instrument calibration procedures, analytical methods, standard operating procedures (SOPs), and data management procedures are for the methods being used. Information on WVDEP's Laboratory Quality Assurance Program can be obtained by accessing the following internet address:

<http://www.dep.wv.gov/WWE/Programs/lab/Pages/default.aspx>.

3.0 DATA GENERATION AND ACQUISITION

Prior to the on-site initiation of an investigation, the OER Project Manager will review the files and, if applicable, review the subject facility's compliance history and any relevant submissions or other historical data that might be relevant to the project. If appropriate, the OER Project Manager will confer with counterparts from other programs to determine if there are multimedia or cross-program concerns to be aware of or to be addressed during the inspection. Finally, the OER Project Manager ascertains what equipment (such as field screening equipment or sampling materials) will be necessary to accomplish his/her investigation goals.

3.1 Sampling Methods Requirements

The purpose of performing an investigation is to determine the presence and identity of contaminants, along with the extent to which they have become integrated into the surrounding environment. The objective is to collect and analyze samples which are representative of the media under investigation. The conceptual site model (CSM) will be used for development of the sampling program. The purpose of the model is to provide a visual representation of and to identify the following:

- Anticipated contaminants
- Primary and secondary source areas
- The release mechanism
- Potential migration pathways
- Anticipated media of concern
- Potential exposure pathways
- Potential receptors

The CSM is developed based upon the historical information about former site activities, any available data about the physical and chemical characteristics of the media of potential concern, and a listing of the potential environmental receptors of concern. Based on the CSM, crucial pathways and media requiring assessment can be identified and later be used to evaluate whether the data makes sense for what is known about the site. The various sampling strategies that can be employed at a specific site can be grouped into two basic categories: statistical methods and non-statistical methods. Applications and limitations of each sampling strategy are briefly described in Table 1. Specific sampling strategies and sample locations shall be described in the site-specific SAPs that are developed for each site. A site-specific QAPP shall be generated for each project. This document may be a separate document from the site-specific SAP or may be included as an appendix in the site-specific SAP. The site-specific QAPP should generally follow the outline of this generic QAPP while addressing the site-specific issues for the given project. The site-specific QAPP should include, but not be limited, to the following:

- Project Description
 - Identification of project personnel including contractors and subcontractors
 - The appropriate chain of command for the project
 - Any special training requirements
- Site Description
 - Site history, including a summary of any previous data collected, soil geology, groundwater information, and any previous actions taken at the site
- Sampling Plan
 - Applicable regulations and action limit rationale
 - Sample locations and frequency (in tabular format as well as in figures)
 - Sample matrices, sample type (composite, grab, field screening, etc.) and number of samples required, including justification for type and number of samples
 - Identification of critical samples
 - Identification and location of background samples
 - Identification of required field QC samples (field duplicates, rinsates, trip blanks, MS/MSD, etc.)
 - Sampling handling and custody requirements
 - Data acquisition requirement for non-direct measurements
- Sample Analysis
 - Sampling and analysis methods, including SOPs and potential discussion of method detection limit issues
 - Identification of the laboratory (WVDEP Certified Laboratory required)

- Identification of required laboratory QC (demonstration of detection and reporting limits, calibrations, method blanks, laboratory control samples, etc.)
- Maintenance
 - Instrument/equipment maintenance and calibration frequency for both field and laboratory equipment
- Data Quality
 - Data quality objectives and criteria for measurement data (accuracy, precision, completeness, representativeness, and comparability)
 - Data quality indicators
 - Data management (including sample documentation, SOPs for both field and laboratory, and analytical data deliverable requirements)
 - Assessment and oversight, including performance and system audits for both field and laboratory and the frequency for oversight of field activities
 - Discussion of the methodology and level of data validation

The methods and equipment used for sampling environmental matrices vary with the associated physical and chemical properties. Sample collection and preservation procedures will be conducted in accordance with *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (commonly known as SW-846) and/or other EPA approved sample collection and preservation procedures for the appropriate media sampled, including soils, sediments, sludge, waste material, surface water, groundwater, and, in some cases, air monitoring. Soils and sediment data should be reported on a “dry weight” basis. In order to allow data validation in accordance with EPA protocols, the analytical laboratory should generate documentation equivalent to a full Contract Laboratory Program (CLP) deliverables package for projects within the Voluntary Remediation Program and for those seeking closure under the UECA Program. With respect to samples collected for the LUST Program or samples collected for waste characterization purposes, documentation equivalent to a full CLP deliverable package is generally not warranted, unless the responsible party intends to bring the LUST site into the VRP or will seek risk based closure under UECA.

To ensure that uniform and acceptable sampling protocols for each project are being used, the sampling requirements found in Table 2 will be used for all applicable site-specific projects. It is noted that additional analytical parameters in addition to those listed in Table 2 may be required for specific projects. In this event, the site-specific SAP will list the additional analytical parameters and provide the sampling requirements for those parameters. Furthermore, these new analytical parameters will be added to the QAPP upon review and revision, as appropriate.

Prior to the initiation of data collection activity designed to evaluate environmental conditions at a site, a site-specific Sampling and Analysis Plan will be prepared. The SAP shall:

- Logically evaluate available site information.
- Specify site-specific Measurement Quality Objectives for precision, accuracy and completeness for each parameter being measured.
- Select an appropriate sampling design.
- Select and utilize suitable geophysical, analytical screening, and sampling techniques.
- Employ proper sample collection and preservation techniques.
- Describe the collection and analysis of the appropriate QA/QC samples.
- Logically present and interpret analytical and geophysical data.
- Define data usability criteria.

The SAP shall include, but not be limited to:

- Project Description
 - Identification of project personnel, including contractors and subcontractors
 - Appropriate chain of command for the project
 - Any special training required
 - Project schedule
- Site Description
 - Site location (in text, as well as figures)
 - Site description, including ownership, size, tax parcels, site access, current use, topography, groundwater flow (if known), adjoining properties, etc.
 - Figures that clearly depict site boundary overlaid on a topographic map, road map, and aerial, as appropriate, with structures and areas of concern labels
 - Site history including a summary of any previous data collected, soil geology, groundwater information, and any previous actions taken at the site
- Sampling Plan
 - Applicable regulations and action limit rationale
 - Identification of the laboratory (WVDEP Certified Laboratory required)
 - Sample locations, matrices, sample types (composite, grab, field screening, etc.), and number of samples required with justification for type and number of samples (in tabular format, as well as in figures)
 - Justification for type and number of samples
 - Identification and location of critical samples, if applicable

- Identification of QC samples (field duplicates, rinsates, trip blanks, MS/MSD, etc.)
 - Identification and location of background samples
 - Detailed discussion of sample collection techniques for each sample type (with SOPs, if applicable)
 - Discussion of analytical methods to be used (listing specific methods, specific compound/analyte lists, project required reporting limits, etc.)
 - Sample handling, preservation, and chain-of-custody requirements
 - Discussion of field screening techniques and/or field data collection (summary of technique, equipment used, calibration and maintenance requirements, appropriateness of the method, etc.)
 - Data acquisition and management, including sample documentation to be used (field logbooks, boring logs, photographs, recording of non-direct measurements, etc.)
 - Decontamination procedures and disposal of investigative derived waste (IDW)
 - Data Quality Objectives, the level of data validation required, and the number or percentage of samples to be validated
- Site-specific Health and Safety Plan (HASP) and Quality Assurance Project Plan (QAPP) as appendices if they are not to be submitted as separate documents

During the initiation of data collection activities, standard operating procedures are followed pertaining to sampling methods. Sample collection SOPs and equipment decontamination procedures are provided in Appendix B with the understanding that the SOPs presented are not all inclusive of the types of media, sampling, and decontamination procedures that may be performed at any given site. As appropriate, SOPs for situations not addressed in Appendix B will be required in a site-specific SAP. Furthermore, these new SOPs will be added to the QAPP upon review and revision, as appropriate. Sometimes problems may be encountered in the field or laboratory and/or unexpected results may be found at a site which necessitates additional site characterization. In such cases, an addendum must be made to the site-specific SAP and QAPP that addresses these findings and provides for procedures for additional site characterization activities.

Also, it is noted that SOPs are not provided in Appendix B for the various laboratories used by OER since OER only allows the use of WVDEP Certified Laboratories. For certification, laboratories must submit their SOPs to the WVDEP/DWWM Laboratory Quality Assurance Program, which is responsible for ensuring that certified laboratories meet state requirements.

3.2 Sample Handling and Custody Requirements

All field documentation should be completed in indelible ink. Errors in field sampling documents shall be corrected by drawing a single line through the error, writing in the correction, and initialing and dating the correction.

Sample labels are required to properly identify the samples. All samples will be labeled in the field, and care will be taken to assure that each sample container is properly labeled. The samples will be placed in sealed plastic bags to prevent the labels from soaking off or becoming illegible from exposure to ice/water during transport to the laboratory. Labels will contain the following information:

- Project name and designated project number
- Sample identification number
- Date and time sample was collected
- Description of sample
- Sampling location
- Notation of whether preservatives were added to sample and type of preservative
- Type of sample (such as grab or composite)
- Type of analysis requested

Chain-of-custody procedures provide documentation of the handling of each sample from the time it is collected until analysis is completed. Chain-of-custody procedures are implemented so that a record of sample collection, transfer of samples between personnel, sample shipping, and receipt by laboratory that will analyze the sample is maintained. The chain-of-custody record serves as a legal record of possession of the sample. To simplify records and eliminate potential litigation problems, as few people as possible should handle the samples during the investigation. All samples will be maintained in accordance with the following chain-of-custody procedures. A sample is considered to be under custody if one or more of the following criteria are met:

- In a person's physical possession
- In view of that person after he/she has taken possession
- Secured by that person so that no one can tamper with the sample
- Secured by that person in an area which is restricted to authorized personnel

A chain-of-custody record must always be maintained from the time of sample collection until final deposition. An example of a chain-of-custody form is found in Figure 2. Every transfer of custody will be noted and signed for with a copy of the record being kept for each individual who endorsed it. At a minimum, the chain-of-custody record includes the following information:

- **Project Description**
 - Project number and site location
 - Name and contact information of project manager
- **Laboratory Information**
 - Name of WVDEP Certified Laboratory where samples will be analyzed
 - Means of results transmittal (such as e-mail, mail, or fax)
 - Turnaround time requested
 - Data deliverables
- **Sample Information**
 - Sample identification number(s)
 - Description of sample(s)
 - Date and time sample(s) collected
 - Notation of whether preservatives were added to the sample(s) and type of preservative(s) added
 - Type of sample(s) (such as grab or composite)
 - Matrix of sample(s) (i.e. water, soil, sludge, and so forth)
 - Amount of sample being transported to the laboratory, along with the number and type of containers
- **Analysis Requested**
 - The appropriate analytical parameters to be tested and analytical method
 - Any other information, such as field screening data, that the sampler feels is pertinent to the analysis of the sample(s)
- **Sampling Handling**
 - Names and signatures of samplers
 - Signatures of all individuals who have had custody of the samples

Custody seals will be placed on all samples. Refer to Figure 3 for an example of a custody seal and Figure 4 for sample container labels. When preparing sample containers for shipment, the containers will be securely sealed. The custody seals will be used to demonstrate that a sample container has not been opened or tampered with. The individual who has sample custody shall always sign, date, and affix the custody seal to the sample container in such a manner that it cannot be opened unless it is broken. When samples are not under direct control of the individual responsible for them, they will be stored in a container, which will be affixed with a custody seal.

Samples will then be placed in an appropriate transport container and packed with an appropriate absorbent material such as vermiculite. All sample containers will be packed to maintain a temperature of $\leq 6^{\circ}\text{C}$, but without freezing the sample. A temperature blank will be added to each transport container that contains samples for volatile organic compound (VOC) analysis. All sample documentation will be placed in a plastic bag and affixed to the underside of each transport container lid. The transport container lid will then be closed and affixed with a custody seal accordingly. Samplers will transport environmental samples directly to the laboratory within 24 hours of sample collection, arrange for pickup by the laboratory sample courier within 24 hours of sample collection, or utilize an overnight delivery service within 24 hours of sample collection.

All of the appropriate Department of Transportation (DOT) regulations for packaging, marking/labeling, and shipping hazardous materials and wastes will be followed. Air carriers that transport hazardous materials will comply with the current edition of the International Air Transport Association (IATA) Dangerous Goods Regulations, which detail the procedures to be used to enable the proper shipment and transportation of hazardous materials by a common air carrier. Following the current IATA regulations will ensure compliance with state and federal DOT regulations.

3.3 Analytical Methods Requirements

Analytical methods will be selected to achieve project objectives. Each site-specific SAP will identify analytical method numbers, extraction and/or digestion method numbers, method detection limits, and quantitation limits for each parameter. The SOPs for analytical methods will be included as an appendix in the site-specific SAP.

Where appropriate, the use of field screening or field analytical methods may be used as part of site characterization efforts. The SOPs for these methods, if used, will be included as an appendix in the site-specific SAP. The SOPs should include a discussion of the field screening or field analytical methods that identifies the type(s) of instrumentation proposed for use, the relevant analytical procedure, the capability of the procedure to identify a compound or class of compounds, and the associated measures (i.e. instrument checks, calibrations, and so forth) designed to ensure that the field generated data meets the requirements for its intended use. The SOPs should also specify the percentage of the field screening samples, if appropriate for the data needs, which will be sent to a fixed laboratory for subsequent laboratory analyses and validation. Furthermore, the SOPs should outline the approach to be used for comparing the field screening results, where appropriate, to the fixed laboratory data in order to establish the reliability of the field screening data. To the extent practical, the majority of samples sent to the fixed laboratory should correspond to field screening results at or near “action levels,” with the remainder of the samples divided equally between “high” results and “non-detects.”

3.4 Quality Control Requirements

3.4.1 Field Activities

Field QC is as vital to a project as is quality control within the laboratory. Proper execution of each project task is needed in order to yield consistent reliable information that is representative of the media and conditions being measured. The overall quality assurance objective is to ensure that data of known quality is generated so that it will be useful in meeting the intended project objectives. The OER Project Manager will be responsible for seeing that field personnel adhere to the QAPP and site-specific SAP. As needed, the OER Project Manager will confer with the QAM and/or risk assessor, when appropriate on issues that may affect quality control and the attainment of data quality objectives. The general field quality control requirements (for QC sample type, frequency, acceptance criteria, and corrective action) found in Table 3 shall serve as a guideline for all OER projects. It is noted that the field quality control requirements provided in Table 3 are for guidance purposes only and that field quality control requirements for a specific project will be dependent upon the data quality objectives of that project and may differ from those criteria listed in this table. In cases where the field quality control requirements are different than that listed in Table 3, the appropriate requirements will be specified in the site-specific SAP.

Furthermore, it is noted that for certain categories of samples, the collection of field quality control samples (i.e. duplicates, splits, matrix spikes, etc.) may not be the best method of ensuring attainment of DQOs. The decision to omit some types of field quality control samples for a given project may be made by the OER Project Manager, in consultation with the QAM. Omission of these samples should be based on meeting project objectives and goals, rather than simply to reduce cost. The sample categories that may not be good candidates for some field quality control sample collection are described below with the understanding that the decision not to collect certain QC samples (such as splits, duplicates, matrix spikes, etc.) must clearly be discussed in the SAP. The sampling protocol proposed must ensure attainment of the DQOs. It should be noted that while the collection of some types of field QC samples may not be suitable for these categories, almost assuredly some form of field QC sampling such as trip blanks, equipment rinsate blanks, temperature blank, and so forth are still applicable to these categories. Furthermore, several laboratory QC procedures would also apply to these categories of samples:

- | | |
|------------------------------|---|
| <u>Treatability Studies:</u> | Samples collected as part of a treatability study to demonstrate the efficacy of a remedial process may not typically employ split or duplicate samples. |
| <u>Process Monitoring:</u> | Samples collected to demonstrate the day-to-day effectiveness of intermediate steps during a treatment process may not typically employ split or duplicate samples. |
| <u>Wipe Samples:</u> | Wipe samples (for polychlorinated biphenyls or lead) would not typically employ duplicate or split samples. |
| <u>Screening Data:</u> | Samples collected as part of a screening program would not typically employ duplicate or split samples. |

3.4.2 Laboratory Activities

A WVDEP Certified Laboratory shall be used to perform all analytical work for projects regulated by and/or directed by OER. The contract laboratory will be responsible for ensuring that their personnel adhere to their laboratory's SOPs and Quality Assurance Plan (QAP). The number and types of internal QC checks for each analytical method must be defined in the laboratory's QAP. The site-specific SAP will reference the required minimum quality control requirements for the laboratory that will be incorporated into the QAPP as a table of Analytical Quality Control Requirements taken from the Laboratory Qualifications Package and based upon the Laboratory Certification and Standards of Performance Rules. The laboratory must follow the quality objectives for precision, accuracy, representativeness, comparability, completeness, and method detection limits as set forth in their laboratory QAP. Laboratory internal QC results should include information about agreement between replicate analyses, spike and surrogate recoveries. Analysis of laboratory control samples, method blanks, matrix spikes, and duplicates must be included with each analytical batch in accordance with SW-846 requirements, and soils and sediment data should be reported on a "dry weight" basis. In addition, the requirements outlined in Table 3 of the Quality of Purified Water Used in Microbiology Tests found in the *Laboratory Certification and Standards of Performance Rule* (WV CSR Title 47, Series 32) must be followed when microbiological tests are performed.

The UECA Program and Voluntary Remediation Program data deliverable format is typically a Contract Laboratory Program (CLP) – like data deliverable package. With respect to samples collected for the LUST Program and for waste characterization purposes, documentation would be similar to that collected for the Voluntary Remediation Program, but less detailed than the full CLP-like package. Refer to Section 3.7.5 for a description of the items typically included in a data deliverable package for the LUST Program and for waste characterization purposes.

3.5 Instrument/Equipment Maintenance Requirements

3.5.1 Field Equipment

All field equipment will be maintained in accordance with each respective instrument manufacturer's operating instructions. All maintenance activities will be recorded in a logbook. For field equipment, the preventive maintenance information found in Table 4 will be used. Spare parts for the specific field equipment may be available from the manufacturer as noted in the equipment manufacturers operating instruction booklet and in Table 4. It is noted that the field equipment listed in Table 4 are specific to the common field equipment that OER Project Managers currently have available to them. It is possible that other field equipment may be utilized on-site (equipment may be rented or contractors may have different equipment). If this is the case, field equipment maintenance requirements will be required to be addressed in the site-specific SAP.

3.5.2 Laboratory Equipment

The contract laboratory will be responsible for ensuring that their personnel adhere to the instrument/equipment maintenance requirements outlined in their Quality Assurance Plan. The instrument/equipment maintenance requirements shall conform to the manufacturer's specifications for each instrument and shall comply with all requirements of SW-846 and the WVDEP Laboratory Certification Program.

3.6 Instrument Calibration and Frequency

3.6.1 Field Equipment

Field equipment will be calibrated following the procedures found in Table 5. When the acceptance criteria are not met, the corrective actions found in Table 5 will be implemented. It is noted that the field equipment listed in Tables 4 and 5 are specific to the common field equipment that OER Project Managers and/or consultants routinely use at sites. It is possible that other field equipment may be utilized on-site (equipment may be rented or contractors may have different equipment). If this is the case, field equipment calibration and acceptance criteria/corrective action will be required to be addressed in the site-specific SAP. If OER acquires additional equipment, that equipment will be added to the table during revisions to the QAPP.

3.6.2 Laboratory Equipment

The contract laboratory will be responsible for ensuring that their personnel adhere to the instrument calibration procedures outlined in their Quality Assurance Plan. The instrument calibration procedures shall conform to the requirements of SW-846 and the WVDEP Laboratory Certification Program.

3.7 Data Management

3.7.1 Sample Documentation

Field sample documents such as the chain-of-custody, field logbook, and so forth will be legibly written in ink. Any corrections or revisions to sample documentation shall be made by lining through the original entry and initialing and dating any changes. To reiterate these requirements, the following sub-sections are provided to outline sample documentation procedures that will be employed when conducting this investigation.

3.7.2 Field Logbook

The field logbook is a descriptive notebook detailing site activities and observations so that an accurate and factual account of field procedures may be reconstructed. All entries in the field logbook will be signed by the person making the entries. All field logbook entries will document the following specifics:

- Dates and times of entries
- Site name and project number
- Contractor name and address
- Names of all personnel on site
- Weather conditions
- Descriptions of all relevant site activities, including site entry and exit times
- Site observations
- Dates and times of sample collections and chain-of-custody information
- Identification and description of samples and locations
- Noteworthy events and discussions
- Records of photographs and site sketches
- All relevant and appropriate information delineated in field data sheets and sample labels

3.7.3 Standard Operating Procedures

Standard operating procedures are often developed for many laboratory and field activities. When applicable and available, SOPs will be utilized in project data collection. To ensure environmental sample collection efforts are comparable, procedures found in sampling SOPs will be followed. Various SOPs for sample collection are located in Appendix B. In the event that the SOPs in Appendix B do not address a sample collection method necessary for a site, then a SOP shall be submitted in the site-specific SAP that addresses the sample collection procedures not previously addressed. The site-specific SAP will include SOPs for all field-screening methods and for non-EPA approved methods. As appropriate, these new SOPs will be added to the QAPP upon review and revision. Laboratory SOPs are submitted to the WVDEP/DWWM Laboratory Quality Assurance Program and approved in accordance with lab certification procedures.

3.7.4 Field Data Records

All real-time measurements and observations will be recorded in project logbooks, field data records, or in similar types of record keeping books. Field data records will be organized into standard formats whenever possible, and retained in OER's permanent files.

3.7.5 Analytical Data Deliverable Requirements

At a minimum, analytical data deliverable packages provided by the laboratory will be in an organized, legible, and tabulated manner. Data deliverable requirements for the LUST Program and for waste characterization samples normally are less stringent than those required for the Voluntary Remediation Program and would generally include the following, as applicable:

- Chain-of-custody
- Sample documentation (location, date and time of collection and analysis, etc.)
- Analyte(s) identification
- Analyte(s) quantitation
- Determination and documentation of detection limits
- Surrogate recovery
- Initial and continuing calibration
- Dilution factor
- Moisture content (data for soils and sediments must be reported on a dry weight basis)
- Matrix spike and matrix spike duplicate recoveries
- Signature of laboratory representative
- Sample paperwork, both preparatory and analysis
- QC blanks, including method blank/instrument blank, trip, field, and/or equipment rinse blanks
- Quality control sample results (duplicate and/or split results)
- Laboratory sample receipt documentation indicating the condition of samples upon receipt at the lab

Data deliverable requirements for the UECA Program and Voluntary Remediation Program normally are more stringent than those required for the LUST Program and would generally include the requirements for the LUST program listed above in addition to the following:

- Chromatograms
- Internal standards recovery and retention times
- Peak integration and labels
- Mass spectra library comparisons, including tentatively identified compounds
- Initial calibration verification results
- Continuing calibration verification results
- Laboratory control matrix spike results

For the UECA Program and Voluntary Remediation Program, prior to submitting samples to the laboratory, a request should be made to the laboratory to submit a target analyte list with each analysis for SW-846 methods such as 8260B and 8270C. The UECA Program and Voluntary Remediation Program deliverable format would typically be a Contract Laboratory Program

(CLP) deliverable package. With respect to samples collected for the LUST Program or samples collected for waste characterization purposes, documentation equivalent to a full CLP deliverable package is generally not warranted, unless the responsible party intends to bring the LUST site into the Voluntary Remediation Program or pursue closure under the LUST-UECA pathway. The analytical data deliverable format for both programs is generally electronic, as a PDF or Excel file, on a CD. Electronic copies may also be submitted via e-mail. Hard copies are generally available on request. Prior to submission of laboratory data to OER, the laboratory's Quality Assurance Officer will review the data for accuracy, precision, and completeness.

3.7.6 Data Management Procedures

All data collected during the sampling activities, including field and laboratory activities, will be recorded, reduced, reviewed, and reported. The OER Project Manager, contractor, subcontractor, and LRS are responsible for these functions for field sample data. Each off-site contract laboratory receiving field samples is responsible for the recording, reduction, reviewing, and reporting of the corresponding analytical results. Analytical data will be obtained from the laboratory, when appropriate, in the form of generic electronic data deliverables (EDDs).

Hard copies of information relating to a site are placed in files in the file room while actions at the sites are ongoing. Once a site attains a "No Further Action" or "Certificate of Completion" action, then all hard copies of information related to the site are scanned and retained electronically in the WVDEP database, indefinitely. The hard copies are then boxed, indexed, and sent for indefinite storage to the WVDEP archives. Submittals of electronic information are retained within the WVDEP database, and all electronic files are backed-up daily.

3.8 Data Acquisition Requirements for Non-Direct Measurements

Non-direct measurements refer to data and other information that has been previously collected or generated under some effort outside the specific project being addressed. Non-direct measurement data may include data from inspection activities, computer models, literature files, or computer databases. Refer to Appendix D for a copy of various inspection forms and checklists used by OER.

The use of data from non-direct measurements should be evaluated to determine its appropriateness for a specific project. It is anticipated that the use of non-direct measurement data for specific projects will be addressed in a site-specific Quality Assurance Project Plan for the site. In some instances, OER or contractors may provide the site-specific Quality Assurance Project Plan as a section within the site-specific SAP. The following issues regarding information on how non-direct measurements are acquired and used on the project will be addressed in the site-specific plans for the project:

- The need and intended use of each type of data or information to be acquired
- How the data will be identified or acquired, and the expected sources of the data
- The method of determining the underlying quality of the data

- The criteria established for determining whether the level of quality for a given set of data is acceptable for use on the project

Furthermore, the acceptance criteria for the data should also be addressed in the site-specific plans for the project. In general, the acceptance criteria for individual data values address issues such as the following:

<u>Representativeness:</u>	Representativeness expresses the degree to which the data is sufficiently similar. Were the sampling and analytical methods used to generate the collected data acceptable to the project?
<u>Bias:</u>	Are there characteristics to the data that may shirt the conclusions? Is there sufficient information to estimate and correct bias?
<u>Precision:</u>	What is the estimate of the viability of the data?
<u>Qualifiers:</u>	Has the data been evaluated in a manner that will allow for logical decisions to be made about the applicability of the data for use in the project?
<u>Summarization:</u>	Is the data summarization process clear and sufficiently consistent with the goals of the current project?

4.0 ASSESSMENT AND OVERSIGHT

4.1 Performance and System Audits

Internal and external performance and systems audits may be undertaken to evaluate the capability and performance of the total measurement system during data collection and management activities. Audits may be utilized to ensure that field and laboratory activities will provide data reflective of the site and its conditions.

A performance audit is performed to evaluate the accuracy of the total measurement system or a component thereof. A systems audit focuses on evaluating the principal components of a measurement system to determine proper selection and use. In regard to field sampling operations, this oversight activity is performed to critique the quality control procedures that are to be employed. Systems audits of this nature may be performed periodically prior to or shortly after field operations commence and until the project is completed.

4.1.1 Field Activities

Analytical procedures are often targeted as the main source of error in data analysis, but generally only represent a minimal contribution to the total error. Field errors are often the major

source of error. Potential sources of field error are sample collection, sample handling, transport, preparation, preservation, and sample identification.

Quality assurance of field sampling activities requires oversight of the various tasks involved in the field operations. Field oversight assures that approved methods and procedures are utilized in performing the work. Data generated for all projects must be of known quality and should also be technically and legally defensible. The necessity for and frequency of field sampling oversight shall be addressed in the site-specific SAP once the scope and objectives of the proposed task are documented. Prior to the initiation of any field sampling activities, the OER Project Manager must approve all sampling and analytical protocols for technical adequacy to ensure field personnel will collect samples properly during the field sampling activities.

Oversight applies to both contract and in-house executed field sampling activities for any project phase. As needed, the OER Project Manager and risk assessor will consult with the QAM concerning the technical adequacy of Sampling and Analysis Plan.

Field audit checklists are useful tools in conducting and documenting that approved protocols are being followed. In general, the OER Project Manager is responsible for performing field audits; however, the OER Project Manager may request that the QAM perform a field audit. Checklists that may be used by the OER Project Manager and/or QAM for various field sampling activities are presented in Appendix D. The approved site-specific SAP, along with the field audit checklists, may be used as the basis for conducting field sampling oversight. As necessary, field audit checklists will be developed to address field sampling activities not described in Appendix D.

The OER Project Manager or QAM will observe and monitor field sample collection activities and records including, but not limited to the following: sample handling, preservation, packaging, shipping, and custody procedures and records; and field equipment operation, maintenance, and field calibration procedures and records. The frequency and duration of oversight visits should be determined by the OER Project Manager. The number of site visits and level of scrutiny will depend on the nature, length and complexity of the project, as well as past performance of the field sampling personnel and the intended use of the data. Oversight of field sampling activities should be carried out on both an announced and unannounced basis. Oversight during the first stages of a field event and during sampling of critical locations or sample media should be a priority. Field audits will evaluate compliance with the requirements of the QAPP and the project SAP employed by site personnel, to verify that:

- field activities are in conformance with documents governing project operations;
- actual practice agrees with written instructions;
- appropriate field logbooks have been established; and
- deficiencies have been addressed and appropriate corrective actions have been initiated.

4.1.2 Laboratory Activities

All contracted laboratories must participate in a performance evaluation audit program covering all analyses being performed by that laboratory. This audit must be performed in accordance with Section 3.10 WV CSR Title 47, Series 32, *Environmental Laboratories Certification and Standards Performance*. The WVDEP/DWWM Laboratory Quality Assurance Program Manager is responsible for ensuring that certified laboratories meet state requirements and ensure that they perform audits and implement corrective actions as necessary to maintain their certifications in accordance with WV CSR Title 47, Series 32. A copy of WV CSR Title 47, Series 32 is located in Appendix C of this plan.

4.2 Reports to Management

The OER Project Manager—in consultation with the QAM—will prepare any field audit results, including situations identified, corrective actions implemented, and overall assessment of field operations. The OER Project Manager will submit the results of field audits to the QAM for review within 30 days of the completion of the audit. Serious deficiencies identified during field audits will be reported to the appropriate personnel by the QAM within two business days of their discovery, with a copy of the report also submitted to the OER Assistant Director. The QAM—in consultation with the OER Project Manager—will begin implementation of corrective action, as needed.

The laboratory audit results, including major and minor situations identified, laboratory response to the problems, impact on data quality, and overall assessment of the laboratory, will be completed by the WVDEP/DWWM Laboratory Quality Assurance Program, and will be made available to OER upon request. Because analytical data submitted to WVDEP is required to be generated by a laboratory certified by the WVDEP/DWWM Laboratory Quality Assurance Program, any data generated by a laboratory that is not certified at the time of the submitted analyses may be rejected, and any additional data will not be accepted until the laboratory is properly certified. OER may require the laboratory to submit a copy of its certification along with a copy of the data deliverable package.

If changes to the QAPP or site-specific SAP are required, the requesting party will initiate the desired change by editing the existing procedure (indicating changes by underlining) and developing a schedule for implementation. The revision will be submitted with a cover letter to the other party for review, comment, and/or approval. Revisions to existing procedures must be reviewed and approved by the OER Project Manager before being incorporated into the QAPP or SAP. Upon acceptance or approval of the revision, the change will be added to the appropriate section of the QAPP or SAP. Changes will be incorporated and documented by marking the revised pages with the revision number and date in the upper right hand corner.

4.3 Corrective Action

The QAM—in consultation with the OER Project Manager—will prepare Corrective Action Reports. The following general procedures are utilized for corrective action when either

immediate or long-term corrective actions are necessary as a result of non-conformance in field and laboratory activities:

- Define the problem.
- Assign the responsibility to an appropriate person to investigate the problem.
- Determine the cause of the problem and describe it.
- Determine the appropriate corrective action to eliminate or minimize the problem.
- Assign an appropriate person to accept responsibility for implementing the corrective action.
- Establish the effectiveness of the suggested corrective action and implement the correction.
- Verify that the corrective action has achieved its goal and the problem has been eliminated.

4.3.1 Field Activities

Field activities that are improper will be corrected as quickly as possible. It is the responsibility of all field personnel to report any problems that might jeopardize the integrity of the data collection and the project QA objectives. The project field manager is responsible to see that the problem is documented, corrective action is taken immediately, and results of the corrective action are documented. In cases where the OER Project Manager is not the project field manager, then the OER Project Manager must be notified as soon as possible for their input into the corrective action procedures. A corrective action report should be written by the field project manager and submitted to OER for inclusion into the project files. The corrective action report should detail the nature of the problem, the proposed corrective action, who was responsible for implementing the corrective action, and who verified that it was executed properly.

4.3.2 Laboratory Activities

The laboratory personnel, usually a QAM or lab supervisor, are responsible for performing corrective actions if a problem occurs at the lab that might jeopardize the integrity of the data and the project QA objectives. Re-analysis of samples is a common acceptable corrective action at the laboratory, provided that hold times have not been exceeded and/or there is sufficient sample volume remaining for a re-analysis. The laboratory is required to report to OER the need for corrective action and the corrective actions taken. The use of defined “flags” to qualify the data and the inclusion of a case narrative with the analytical data are typical ways in which a lab reports corrective actions that are taken.

4.4 Dispute Resolution

In accordance with Section 2.3 of the WVDEP Quality Management Plan, when a dispute is realized, the QAM for the division in which the dispute occurs will attempt to resolve the dispute through negotiation with the parties to the dispute. If a resolution cannot be obtained at this

level, the QAT will be called upon to review the dispute and attempt to reach a mediated resolution. If a resolution cannot be obtained at this level, the dispute will be taken to the Steering Committee for resolution. Finally, if a resolution cannot be obtained at this level, the dispute will be taken to the Executive Committee for resolution. At all levels of dispute resolution, the division directors will be kept advised of the progress of the dispute resolution.

5.0 DATA VALIDATION AND USABILITY

5.1 Data Review

Data review documents possible effects on the data that result from various quality control failures both in the field and in the laboratory. The initial inspection of the data is used to screen for errors and inconsistencies. The OER Project Manager will check the chain-of-custody forms, sample handling procedures, analyses requested, sample description, sample identification, and cooler receipt forms. Sample holding times and preservation are checked and noted. The next phase of data quality review is an examination of the actual data. By examining data from laboratory matrix spikes and duplicates, blind duplicates, trip blanks, equipment blanks, laboratory surrogate recoveries, and field samples, the OER Project Manager can determine whether the data are of acceptable quality. The OER Project Manager will confer with the QAM when there is a question concerning data usability, and the QAM will further evaluate the question of data usability. Refer to Table 6 for guidelines used in evaluating data.

5.2 Data Validation

Data validation is a systematic procedure of reviewing a body of data against a set of established criteria to provide a specified level of assurance of its validity prior to its intended use. Data validation includes assessment of the whole raw data package from the laboratory. It requires that the techniques utilized be applied to the body of the data in a systematic and uniform manner. Standard EPA protocols for validation (i.e., Contract Laboratory Protocol) should be used. However, these protocols may be modified with the approval of the DLR Director, depending on the type of analyses performed and the data quality objectives for the project.

For data validation purposes, the analytical laboratory should be required to generate documentation equivalent to a full CLP deliverables package for the Voluntary Remediation Program. With respect to samples collected for the LUST Program or samples collected for waste characterization purposes, documentation equivalent to a full CLP deliverable package is generally not warranted, unless the responsible party intends to bring the LUST site into the Voluntary Remediation or pursue closure under the LUST-UECA pathway. Refer to Sections 5.2.2 and 5.2.3 for the data validation requirements for the traditional pathway for closure under the LUST Program and for waste characterization purposes.

To expedite redevelopment of sites, preliminary decisions regarding the necessity of follow-up studies or the adequacy of cleanup actions using raw (non-validated) data may be utilized at

certain sites with the understanding that validated data is forthcoming. It should be noted that moving forward in the absence of validated data represents a “calculated risk” and that preliminary decisions based upon non-validated data may need to be revisited.

5.2.1 Voluntary Remediation Program and the UECA Pathway

The Voluntary Remediation Program and the UECA Program utilize risk-based remediation standards as outlined in the Voluntary Remediation Program Guidance Manual. Data is collected under the Voluntary Remediation Program or the UECA Program to delineate the extent of contamination from sites and to formulate remedial actions utilizing risk based standards; therefore, a high level of data validation is required for this program.

The highest degree of data validation is an independent data review (third party validation), which is achieved through the use of a Stage 4 Laboratory Analytical Data Verification and Validation Check. This level of review requires 100% review of all QC elements, including raw data. This represents full validation in accordance with EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (January 2009).

Where sample results are being used for risk-based evaluations or for assessments conducted utilizing brownfield grant moneys in support of redevelopment of brownfield sites, 100% of the analytical data should be validated, irrespective of the actual level of data validation. For this reason, even the use of a lower degree of data validation would require an analytical deliverable package from the laboratory that is equivalent to a full CLP deliverables package. The minimum acceptable level of data validation for risk based closure is Stage 4 validation in accordance with EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (January 2009) cited above.

5.2.2 LUST Program

The LUST Program utilizes specific numerical standards for soil and groundwater cleanup levels. Since the cleanup levels are based upon numerical standards rather than risk-based standards, the level of validation for the program is not as stringent as that set for the Voluntary Remediation Program. Data collected under the LUST Program is used to delineate the extent of contamination from LUST sites and to formulate corrective action plans, which result in the subsequent closure of the sites once specific numerical clean-up standards for soil and groundwater have been reached.

Validation for the LUST Program is performed in general accordance with Stage 2B and Stage 3 levels of EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (January 2009), but only for those program data deliverables listed in Section 3.7.5 of this QAPP. However, if a responsible party anticipates the likelihood of bringing a LUST site into the Voluntary Remediation Program or seeking closure under the LUST-UECA pathway, OER recommends that a full CLP-like data package be obtained and that data validation be performed in full accordance with the requirements of the Voluntary Remediation Program and UECA Program as described above.

5.2.3 Waste Characterization

Documentation equivalent to a full CLP deliverable package is generally not warranted for samples being collected for waste characterization purposes. Validation for waste characterization samples is performed in general accordance with Stage 2B and Stage 3 levels of EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (January 2009), but only for those program data deliverables listed in Section 3.7.5 of this QAPP.

5.3 Reconciliation with User Requirements

The purpose of this element is to outline the acceptable methods for evaluating the results obtained for a given project. This includes scientific and statistical evaluations (refer to Section 5.4) of data to determine if the data is of the right type, quantity, and quality to support the intended use. It is noted that scientific and statistical evaluations of data for specific projects may differ because of differing DQOs. The QC elements in Table 6 will be utilized as a general guideline for the data items requiring review and reconciliation with the DQOs. The DQOs will typically be assessed by evaluating the PARCCS of all aspects of the data collection process.

5.3.1 Precision

Precision will be determined through the use of field duplicates, matrix spike/matrix spike duplicates, and duplicate quality control samples. The Relative Percent Difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed.

The following formula should be used to calculate precision:

$$RPD = \frac{(C_1 - C_2) \times 100}{(C_1 + C_2) / 2}$$

Where: RPD = relative percent difference
C₁ = larger of the two observed values
C₂ = smaller of the two observed values

5.3.2 Accuracy

Accuracy will be assessed through the analysis of quality control samples. The analytical accuracy will be expressed as the percent recovery (%R) of an analyte that has been added to the environmental sample at a known concentration before analysis and is calculated according to the following equation:

$$\% R = \frac{(S-U)}{C_{sa}} \times 100$$

Where: %R = percent recovery

S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

The following formula should be used for measurements where a standard reference material is used:

$$\% R = \frac{C_m}{C_{sm}} \times 100$$

Where: %R = percent recovery
C_m = measured concentration of standard reference material
C_{srn} = actual concentration of standard reference material

5.3.3 Representativeness

Representativeness refers to the degree to which sample data accurately and precisely describe the characteristics of a population of samples, parameter variations at a sampling point, or environmental condition. Samples that are not properly collected or preserved (i.e., contaminant loss or addition) or are analyzed beyond acceptable holding times should not be considered to provide representative data. Representativeness is a parameter that is concerned primarily with the proper design of the sampling program. An assessment of representativeness would include an evaluation of precision. The representativeness criterion is best satisfied in the laboratory by making certain that all aliquots taken from a given sample are representative of the sample as a whole.

This would include sample premixing/homogenizing prior to analysis. Samples requiring volatiles analysis should not undergo any premixing or homogenization. Therefore, noting sample characteristics in a case narrative may assist in evaluating data. Representativeness can be assessed by a review of the precision obtained from the field and laboratory duplicate samples. In this way, they provide both precision and representativeness information. Applicability of representativeness in assessing a contaminant population is improved by using a larger number of samples.

5.3.4 Completeness

Completeness is the percentage of measurements that are judged to be usable (i.e., which meet project-specific requirements) compared to the total number of measurements planned. Specified levels of overall (both field and laboratory) completeness, in addition to particular completeness goals for critical samples, should be set as part of the project DQOs in the site-specific SAP. It is important that critical samples are identified and appropriate QC maintained to ensure that valid data are obtained in order to secure the requisite type, quantity, and quality of data necessary to complete the project. The desired level of completeness is dependent on the project-specific DQOs. This information will be conveyed to the laboratory within the site-specific SAP. Planning and communication among all parties involved in the process are crucial

in order to achieve high completeness percentages. However, completeness goals of 100% are usually unattainable. Realistic completeness goals (i.e., 80-95%) should be determined based upon the size and complexity of the project. Data completeness will be expressed as the percentage of valid data obtained from the measurement system. For data to be considered valid, it must meet all the acceptable criteria including accuracy and precision, as well as any other criteria required by the prescribed analytical method.

The following formula should be used to calculate completeness:

$$\% C = 100 \% \left[\frac{V}{N} \right]$$

Where: %C = percent completeness
 V = number of measurements judged valid
 N = total number of measurements necessary to achieve a
 specified statistical level of confidence in decision making

5.3.5 *Comparability*

Comparability is a quantitative objective of the data, expressing the confidence with which one data set can be compared with another. Sample data should be comparable for similar samples and sample conditions. This goal is achieved through the use of standard techniques to collect representative samples, consistent application of analytical method protocols, and reporting analytical results with appropriate units. Comparability is unknown unless precision and bias are provided. When this information is available, the data sets can be compared with confidence. When new or modified standard reference methods or field analytical techniques are employed, comparability becomes a critical and potentially quantitative data quality indicator. If comparability with standard methods has not been demonstrated, a project-specified percentage of duplicate (split) samples for analysis by the standard reference method should be included. This allows an assessment of comparability between data sets by calculating the RPD, thus determining the usability of the performance-based method in supporting project decision making.

The following formula can be used to calculate the comparability between data sets:

$$RPD = \frac{(C_1 - C_2) \times 100}{(C_1 + C_2) / 2}$$

Where: RPD = relative percent difference
 C₁ = larger of the two observed values
 C₂ = smaller of the two observed values

5.3.6 Sensitivity

Sensitivity is defined by the method detection limits. The achievement of MDLs depends upon the instrument sensitivity to ensure data quality through ongoing checks on instrument performance. The MDL is defined as the minimum concentration that can be measured with 99% confidence that the concentration is above zero.

The MDL is calculated as follows:

$$\text{MDL} = s * t_{(n-1, 1-\alpha=0.99)}$$

Where: s = standard deviation of replicate analysis
 $t_{(n-1, 1-\alpha=0.99)}$ = student's t-value for a one-sided 99% confidence level and a standard deviation estimate with n-1 degrees of freedom

5.4 Statistical Measurements

Various statistical approaches or possibly models may be utilized in data review depending upon the DQOs established for a specific site and will be described in site-specific project plans. At a minimum, data review will commonly include the statistical measurements of central tendency and dispersion. The measurements of central tendency are more meaningful when accompanied by information on how the data is dispersed out from the center.

5.4.1 Measurements of Central Tendency

Measures of central tendency characterize the center of a sample of data points. The three most common estimates of central tendency are mean, median, and mode. The most commonly used measure of the center of a sample is the mean. The mean is an arithmetic average for simple sampling designs. For complex sampling designs, such as stratification, the sample mean is a weighted arithmetic average. The sample mean is influenced by extreme values and non-detects. The sample mean is the sum of all the data points divided by the total number of data points.

The sample median is the second most commonly used measure of the center of the data. This values falls directly in the middle of the data when the measurements are ranked in order from the smallest to largest. The median is another name for the 50th percentile. The median is not influenced by extreme values and can easily be used in the case of non-detects. The sample median is the center of the data when the measurements are ranked in order from smallest to largest.

The third method of measuring the center of the data is the mode. The mode is the value of the sample that occurs with the greatest frequency. Since this value may not always exist, or if it does it may not be unique, this method is the least commonly used measure of central tendency. To find the mode, count the number of times each value occurs. The sample mode is the value that occurs most frequently.

5.4.2 Measurement of Dispersion

Measures of dispersion in a data set include calculation for the range, variance, sample standard deviation, and coefficient of variation. The easiest measure of dispersion to compute is the sample range. For small data sets, the range is easy to interpret and may adequately represent the dispersion of the data. For larger data sets, the range may not be as informative about the data since it only considers the extreme values. The sample range is the difference between the largest value and the smallest value of a data set.

The variance measures the dispersion from the mean of a data set. A small sample variance implies that there is little spread among the data so that most of the data are near the mean. A large sample variance implies that there is a large spread among the data so that most of the data are not clustered around the mean. The sample variance is affected by extreme values and by a large number of non-detects.

The sample variance can be computed by the following equation:

$$S^2 = \frac{\sum_{i=1}^n X_i^2 - 1/n \left\{ \sum_{i=1}^n X_i \right\}^2}{n-1}$$

Where: S^2 = sample variance
 X_i = data points
 n = total number of data points

Sample standard deviation is the square root of the sample variance. It has the same unit of measure as the data.

The coefficient of variation is a measure that allows the comparison of dispersion across several sets of data. The coefficient of variation is often used in environmental applications because variability expressed as a standard deviation is often proportional to the mean. The coefficient of variation is the standard deviation divided by the sample mean. The coefficient of variation is often expressed as a percentage.

6.0 REFERENCES

The following reference materials were used in compiling the information contained in this QAPP:

Corrective Action Plan Guidance Document (CAGD), West Virginia Department of Environmental Protection, Division of Land Restoration, Office of Environmental Remediation, August 2001

Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, United States Environmental Protection Agency, November 2001

EPA Quality Manual for Environmental Programs, 5360 A1, United States Environmental Protection Agency, May 2000

Guidance for Data Quality Assessment, EPA QA/G-9, United States Environmental Protection Agency, January 1998

Guidance for Developing Quality Systems for Environmental Programs, EPA QA/G-1, EPA/240/R-02/008, United States Environmental Protection Agency, November 2002

Guidance on Environmental Data Verification and Data Validation, EPA QA/G-8, United States Environmental Protection Agency, November 2002

Guidance for Quality Assurance Project Plans, EPA QA/G-5, United States Environmental Protection Agency, December 2002

Guidance for the Data Quality Objectives Process, EPA QA/G-4, United States Environmental Protection Agency, February 2006

Guidance for the Preparation of Standard Operating Procedures (SOPs), EPA QA/G-6, United States Environmental Protection Agency, March 2001

Quality Management Plan, West Virginia Department of Environmental Protection, May 2016

User Guide for Risk Assessment of Petroleum Releases, West Virginia Department of Environmental Protection, Division of Land Restoration, Office of Environmental Remediation, Version 1.0, November 1999

West Virginia Voluntary Remediation and Redevelopment Act Guidance Document, West Virginia Department of Environmental Protection, Division of Land Restoration, Office of Environmental Remediation, Version 2.1, March 2001

FIGURES

Figure 1: WVDEP OER QAPP Flow Chart

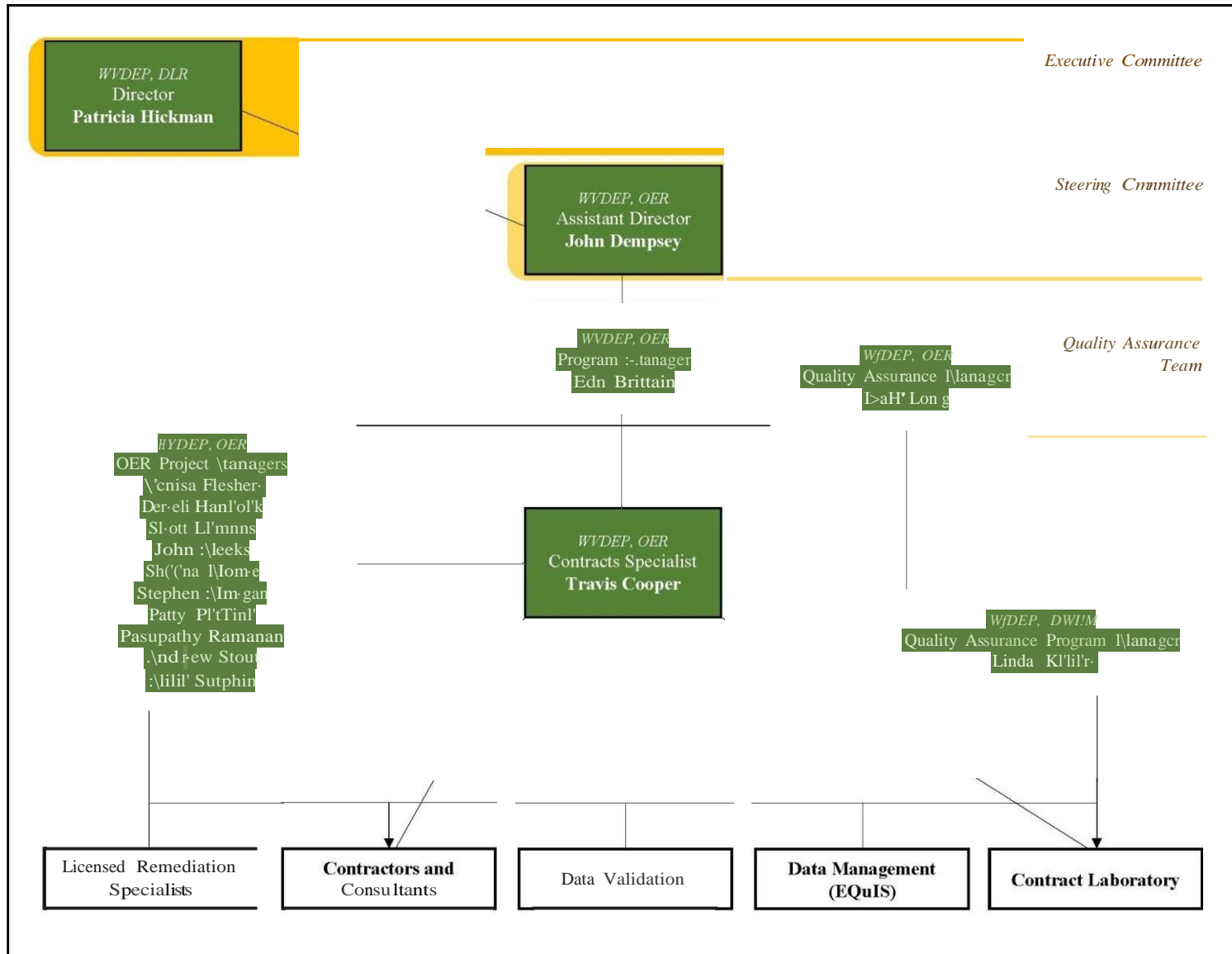



Figure 2: WVDEP Chain of Custody Record


[illegible]

Figure 3: Example Custody Seal

CUSTODY SEAL		QEC Quality Environmental Containers 800-255-3950 • 304-255-3900
DATE	9/21/16	
SIGNATURE	Casey E. Kabin	

Figure 4: Example Labels for Sample Containers

 QEC Quality Environmental Containers			P.O. Box 1160 Beaver, WV 25813 800-255-3950 • 304-255-3900		
PROJECT NAME Hutchinson Property (Leak #04-002)					
SAMPLE ID 04-002-001		SAMPLE DATE 9/21/16		SAMPLE TIME 08:48	
SAMPLED BY CX		PRESERVATIVE Cool to 4°C			
ANALYSIS REQUESTED Total Lead 6010B				<input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE Soil	

 QEC Quality Environmental Containers			P.O. Box 1160 Beaver, WV 25813 800-255-3950 • 304-255-3900		
PROJECT NAME Hutchinson Property (Leak #04-002)					
SAMPLE ID 04-002-MW1		SAMPLE DATE 9/21/16		SAMPLE TIME 10:17	
SAMPLED BY CX		PRESERVATIVE HCL pH < 2 Cool to 4°C			
ANALYSIS REQUESTED BTEX 8021B				<input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE Water	

TABLES

Table 1: Sampling Strategies

Sampling Strategy	Description	Application	Limitation
<i>Statistical Sampling Approaches</i>			
Simple Random Sampling	Representative sampling locations are chosen using the theory of random chance probabilities.	Sites where background information is not available and no visible signs of contamination are present.	Many not be cost-effective for samples located too close together. Does not take into account spatial variability of media.
Stratified Random Sampling	Site is divided into several sampling areas based on background or other site information; each area is evaluated using a separate random sampling strategy.	Larges sites characterized by a number of soil types, geographic features, past/present uses, or manufacturing/storage areas.	Often more cost-effective than simple random sampling. More difficult to implement in the field and analyze results. Does not take into account spatial variability of media.
Systematic Grid Sampling	Involves collecting samples at predetermined, regular intervals within a grid pattern. This is probably the most common statistical strategy.	Best strategy for minimizing bias and providing complete site coverage. Can be used effectively at sites where no background information exists. Ensures that samples will not be taken too close together.	Does not take into account spatial variability of media.
Hot-Spot Sampling	Systematic grid sampling strategy tailored to search for hot spots.	Sites where background information or site investigation data indicates that hot spots may exist.	Does not take into account spatial variability of media. Chance of missing a hot-spot can be high depending upon the amount of site information available.
Geostatistical Approach	Representative sampling locations are chosen based on spatial variability of media.	More appropriate than other statistical sampling strategies because it takes into account spatial variability of media. Especially applicable to sites where presence of contamination is unknown.	Previous investigation data must be available, and such data must be shown to have a spatial relationship.
<i>Non-Statistical Sampling Approaches</i>			
Biased Sampling	Sampling locations are chosen based on available information about site history or past investigations.	Sites with specific known contamination sources.	Contaminated areas can be overlooked if they are not indicated by background information or visual signs of contamination.
Judgmental Sampling	An individual subjectively selects sampling locations that appear to be representative of average conditions.	Homogeneous, well-defined sites.	Not usually recommended due to bias imposed by individual, especially for final investigations.

Table 2: Sample Containers, Preservation, Holding Times

Matrix	Analytical Method	Parameter/Fraction	Minimum Sample Volume ¹	Sample Container ²	Sample Preservation ³	Holding Time
<i>LUST Sites</i>						
Soil ⁴	8021B	Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) <i>Terra Core Samplers</i> (< 200 ug/kg)	3 – 40 ml vials	Glass vial with Teflon lined cap	1g NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01g	14 days
		<i>Terra Core Samplers</i> (> 200 ug/kg)	3 – 40 ml vials	Glass vial with Teflon lined cap	5mL of methanol weight checked to the nearest 0.01g	14 days
		<i>EnCore Samplers</i>	3 – EnCore Samplers	EnCore Sampler	Cool to ≤ 6° C	48 hours
	8021B	Methyl t-butyl ether (MTBE) and t-butyl alcohol (TBA)⁵ <i>Terra Core Samplers</i>	3 – 40 ml vials	Glass vial with Teflon lined cap	Cool to ≤ 6° C, add HCl to pH < 2	14 days
		<i>EnCore Samplers</i>	3 – EnCore Samplers	EnCore Sampler	Cool to ≤ 6° C	48 hours
	8015B	Gasoline Range Organics (GRO) <i>Terra Core Samplers</i> (< 200 ug/kg)	3 – 40 ml vials	Glass vial with Teflon lined cap	1g NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01g	14 days
		<i>Terra Core Samplers</i> (> 200 ug/kg)	3 – 40 ml vials	Glass vial with Teflon lined cap	5mL of methanol weight checked to the nearest 0.01g	14 days
		<i>EnCore Samplers</i>	3 – EnCore Samplers	EnCore Sampler	Cool to ≤ 6° C	48 hours
	8015B	Diesel Range Organics (DRO)/Oil Range Organics (ORO)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap	Cool to ≤ 6° C	14 days

Table 2: Sample Containers, Preservatives, Holding Times

Matrix	Analytical Method	Parameter/Fraction	Minimum Sample Volume ¹	Sample Container ²	Sample Preservation ³	Holding Time
	8270C	Polycyclic Aromatic Hydrocarbons (PAHs)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	14 days
	1311/7420	Lead (Toxicity Characteristic Leaching Procedure – TCLP)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	180 days
Aqueous⁶	8021B	Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)	3 – 40 ml vials	Glass vial with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$, add HCl to pH < 2	7 days
	8021B	Methyl t-butyl ether (MTBE) and t-butyl alcohol (TBA)	3 – 40 ml vials	Glass vial with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$, add HCl to pH < 2	7 days
	8015B	Gasoline Range Organics (GRO)	3 – 40 ml vials	Glass vial with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$, add HCl to pH < 2	7 days
	8015B	Diesel Range Organics (DRO)/Oil Range Organics (ORO)	2 – 1250 ml	1250 ml amber glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	7 days
	8270C	Polycyclic Aromatic Hydrocarbons (PAHs)	2 – 1250 ml	1250 ml amber glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	7 days
Non-LUST Sites						
Soil/ Sediment	8260B	Volatile Organic Compounds	4 oz.	4 oz. clear wide-mouth glass with Teflon lined septum	Cool to $\leq 6^{\circ}\text{C}$	14 days
		<i>(Extraction Method 5035) Terra Core Samples (< 200 ug/kg)</i>	3 – 40 ml vials	Glass vial with Teflon lined cap	1g NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01g	14 days
		<i>Terra Core Samplers (> 200 ug/kg)</i>	3 – 40 ml vials	Glass vial with Teflon lined cap	5mL of methanol weight checked to the nearest 0.01g	14 days
		<i>EnCore Samplers</i>	3 – EnCore Samplers	EnCore Sampler	Cool to $\leq 6^{\circ}\text{C}$	48 hours

Table 2: Sample Containers, Preservation, Holding Times

Matrix	Analytical Method	Parameter/Fraction	Minimum Sample Volume ¹	Sample Container ²	Sample Preservation ³	Holding Time
	8270C	Semi-Volatile Organic Compounds (SVOCs)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	14 days
	8081A	Pesticides	4 oz.	4 oz. wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	14 days
	8082	Polychlorinated Biphenyls (PCBs)	4 oz.	4 oz. wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	14 days
	8270C/8310	Polycyclic Aromatic Hydrocarbons (PAHs)	4 oz.	4 oz. wide-mouth amber glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	14 days
	6010B/7471A	Total Metals	4 oz.	4 oz. clear wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	180 days (28 days Hg)
	SW846/1311, 6010B, 7471	TCLP Metals	9 oz.	9 oz. wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	180 days (28 days Hg)
	SW846/1311, 8260B	TCLP Volatiles	9 oz.	9 oz. wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$, no headspace	14 days until extraction, analyze within 40 days of extraction
	SW846/1311, 8270C	TCLP Semi-Volatiles	9 oz.	9 oz. wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	7 days until extraction, analyze within 40 days of extraction
	SW846/1311, 8081, 8151	TCLP Herbicides and Pesticides	9 oz.	9 oz. wide-mouth glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	7 days until extraction, analyze within 40 days of extraction
Aqueous	8260B	Volatile Organic Compounds	2 – 40 ml vials	40 ml VOC vial with Teflon lined septum	Cool to $\leq 6^{\circ}\text{C}$ 1:1 HCl to pH < 2	14 days

Table 2: Sample Containers, Preservation, Holding Times

Matrix	Analytical Method	Parameter/Fraction	Minimum Sample Volume ¹	Sample Container ²	Sample Preservation ³	Holding Time
	8270C	Semi-Volatile Organic Compounds	1 Liter	1 Liter amber glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	7 days
	8310/8270C	Polycyclic Aromatic Hydrocarbons (PAHs)	1 Liter	1 Liter amber glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	7 days
	8081/8082	Pesticides/PCBs	1 Liter	1 Liter amber glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	7 days
	6010B/7470A	Total Metals	1 Liter	1 Liter HDPE bottle with Teflon lined cap	1 N HNO ₃ to pH < 2 Cool to $\leq 6^{\circ}\text{C}$	180 days (28 days Hg)
	SW846/1311, 6010B, 7470	TCLP Metals	2 Liters	1 Liter HDPE bottle with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	180 days (28 days Hg)
	SW846/1311, 8260B	TCLP Volatiles				
	SW846/1311, 8270C	TCLP Semi-Volatiles	2 Liters	1 Liter amber glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	7 days until extraction, analyze within 40 days of extraction
	SW846/1311, 8081, 8151	TCLP Herbicides and Pesticides	2 Liters	1 Liter amber glass with Teflon lined cap	Cool to $\leq 6^{\circ}\text{C}$	7 days until extraction, analyze within 40 days of extraction
¹ Triple volume is required for matrix spike/matrix spike duplicate (MS/MSD) analysis. ² All sample bottles must comply with the standards outlined in the following reference: U.S. EPA (Environmental Protection Agency). December 1992. Specifications and Guidance for Contaminant-Free Sample Containers. OSWER Directive #9240.0-05A, EPA 540/R-93/051. Office of Solid Waste and Emergency Response, Washington, DC. ³ Cool sample to $\leq 6^{\circ}\text{C}$, but without freezing the sample. ⁴ SW-846 sampling method 5035 may be used for VOCs associated with leaking underground storage tank sites. The sample methodology may also be applicable to non-LUST sites. In addition, Method 8260B may be utilized for BTEX and MTBE analysis as an alternative to Method 8021B. ⁵ If analysis by Method 8021B indicates the presence of MTBE or TBA, confirmation analysis by Method 8260B is required in the LUST Program. ⁶ Methods listed for the LUST Program for aqueous samples may also be applicable to non-LUST sites.						

Table 2: Sample Containers, Preservation, Holding Times

Table 3: Field Quality Control Requirements

Type of QC Sample	Frequency	Acceptance Criteria ¹	Corrective Action ²
Cooler Temperature Blank	One per cooler	6° C	Resample, qualify data as necessary, and/or accept data with an acknowledged level of uncertainty.
Equipment Rinsate Blank	One per twenty samples per matrix per equipment type per decontamination event or one per day, whichever is more frequent	< minimum detection limit or < 30% of lowest sample up to two times the MDL	Reanalyze suspect samples; resample and reanalyze; qualify data as necessary, accepting data with an acknowledged level of uncertainty; recalibrate analytical instruments; and/or discard the data.
Field Blank	One per twenty samples per matrix or one per day, whichever is more frequent	< minimum detection limit or < 30% of lowest sample up to two times the MDL	Reanalyze suspect samples; resample and reanalyze; qualify data as necessary, accepting data with an acknowledged level of uncertainty; recalibrate analytical instruments; and/or discard the data.
Field Duplicate	One per twenty samples per matrix or one per day, whichever is more frequent	50% of RPD or two times the MDL	Reanalyze suspect samples; resample and reanalyze; accept data with an acknowledged level of uncertainty; recalibrate analytical instruments; and/or discard the data.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) ³	One per twenty samples per matrix or one per day, whichever is more frequent	Recovery within 50% for spikes at 10 times MDL	Review chromatograms and raw data quantitation reports; check instrument response using calibration standard; attempt to correct matrix problem and reanalyze sample; resample and reanalyze; accept data with an acknowledged level of uncertainty, and/or discard the data.
Split Sample	10% of field screening data will be confirmed with data from a fixed laboratory ⁴	50% of RPD or two times the MDL	Reanalyze suspect samples; resample and reanalyze; accept data with an acknowledged level of uncertainty; recalibrate analytical instruments; and/or discard the data.
VOA Trip Blank	One for each cooler which contains samples for VOA analyses	< minimum detection limit or < 30% of lowest sample up to two times the MDL	Reanalyze suspect samples; resample and reanalyze; qualify data as necessary, accepting data with an acknowledged level of uncertainty; recalibrate analytical instruments; and/or discard the data.

- ¹ The acceptance criteria provided are for guidance purposes only. The acceptance criteria for a specific project will be dependent upon the data quality objectives of that project and may differ from those criteria listed in this table. In cases where the acceptance criteria are different from that listed above, it will be specified in a site-specific SAP.
- ² The corrective actions provided are for guidance purposes only. The corrective action procedures listed may vary depending upon the data quality objectives and the acceptance criteria provided in the site-specific SAP.
- ³ Sufficient sample will be collected to allow the laboratory to perform this analysis.
- ⁴ The frequency cited is per Superfund Data Quality Objectives Process for Superfund Sites and may not be applicable to all OER projects. The collection of split samples will be dependent upon the data quality objectives for a given site.

Table 4: Preventative Maintenance – Field Equipment

Instrument	Activity	Frequency
Conductivity	Check battery.	Each usage and replace as necessary.
	Check for damage to the probe.	Each usage and replace as necessary.
	Clean probe.	Probe should be rinsed with distilled water after every usage. Clean with manufacturer suggested cleaning solution (usually dilute acid) as necessary.
Dissolved Oxygen	Check battery.	Each usage and replace as necessary.
	Check for damage to the probe.	Each usage and replace as necessary.
	Clean probe.	Probe should be rinsed with distilled water after every usage. Clean with manufacturer suggested cleaning solution as necessary.
MutliRAE Lite	Check battery.	Each usage and charge as necessary.
	Clean PID sensor.	As necessary, as indicated during calibration.
	Replace combustible detector.	As necessary, as indicated during calibration.
	Replace filter element in inlet fitting.	As necessary.
	Replace gas inlet adapter.	As necessary.
	Replace pump.	As necessary.
	Replace O ₂ , CO, H ₂ S, and VOC (PID) sensors.	As necessary, as indicated during calibration (~ 1/yr.).
Oxidation-Reduction Potential (ORP)	Check battery.	Each usage and replace as necessary.
	Check for damage to the probe.	Each usage and replace as necessary.
	Clean probe.	Probe should be rinsed with distilled water after every usage. Clean with manufacturer suggested cleaning solution as necessary.
pH & Temperature Meter	Check battery.	Each usage and replace as necessary.
	Check for damage (scratches, cracks, or breaks) to the probe.	Each usage and replace as necessary.
	Clean probe and store wet.	Probe should be rinsed with distilled water after every usage. Clean with manufacturer suggested cleaning solution (usually dilute acid solution for salt deposits) as necessary.
<p><i>Note that the field equipment listed in Table 4 is specific to the common field equipment that is routinely utilized at a site. It is possible that other field equipment may be utilized on-site (equipment may be rented or contractors may have different equipment). If this is the case, field equipment calibration and acceptance criteria/corrective action will be required to be addressed in the site-specific SAP. If OER acquires additional equipment, that equipment will be added to the table during revisions to the QAPP.</i></p>		

Table 5: Calibration and Corrective Action – Field Equipment

Instrument	Calibration Standards	Frequency	Acceptance Criteria	Corrective Action
Conductivity	Potassium chloride: 1,000 uS/cm \pm 1.0%	Each day of usage	Adjustable to standard	Clean probe if dirty or replace probe if damaged. Remove from service until the unit meets calibration standard.
Dissolved Oxygen	Water saturated air calibration	Each day of usage	Between 100 and 104% oxygen saturation in water-saturated air	Clean probe if dirty or replace probe if damaged. Remove from service until the unit meets calibration standard.
MutliRAE Lite	100 ppm Isobutylene	Each day of usage	Adjustable to standard	Take the unit out of service until the filter or lamp can be cleaned or replaced and the unit meets calibration standards.
	10 ppm H ₂ S, 50 ppm CO, 18% O ₂ , 2.5% CH ₄ (50% LEL)	Each day of usage	Adjustable to standard	Take the unit out of service until the filter or lamp can be cleaned or replaced and the unit meets calibration standards.
Oxidation-Reduction Potential (ORP)	ORP standard iron-salt solutions: 100 mV	Each day of usage	Adjustable to standard	Clean probe if dirty or replace probe if damaged. Remove from service until the unit meets calibration standard.
pH	Buffer solutions: 4.00 \pm 0.01, 7.00 \pm 0.01, 10.00 \pm 0.01	Each day of usage	Adjustable to standard	Clean probe if dirty or replace probe if damaged. Remove from service until the unit meets calibration standard.
Temperature	Check against National Institute of Standards and Technology (NIST) traceable thermometer	Each day of usage	1.0 F of NIST traceable thermometer	Clean temperature probe if dirty or replace probe if damaged. Remove from service until the unit meets calibration standard.
<i>Note that the field equipment listed in Table 5 is specific to the common field equipment that is routinely utilized at a site. It is possible that other field equipment may be utilized on-site (equipment may be rented or contractors may have different equipment). If this is the case, field equipment calibration and acceptance criteria/corrective action will be required to be addressed in the site-specific SAP. If OER acquires additional equipment, that equipment will be added to the table during revisions to the QAPP.</i>				

Table 6: Data Evaluation

QC Element	Type of Failure	Possible Cause ¹	Major PARCCs Affected ²	Possible Effect on Data	Possible Worst Case Data Evaluation Scenario ³
Analysis Method	Wrong method	Incorrect method listed on chain-of-custody, failure to read SAP, incorrect SAP, laboratory analyst error	Accuracy Comparability Completeness Representativeness	False negatives High or low bias	Invalidates or qualifies all or some of the sample results
Chain-of-Custody	Chain broken or not kept	Missing signatures, missing seals, missing dates/times	Completeness	Incomplete data	Data not legally defensible
Detection Limit	Detection limit too high	Insufficient sample, high dilution factor, wrong or inappropriate method	Comparability Completeness	Incomplete data False positives False negatives	Invalidation of sample results
Dilution Factors	Extremely high dilution factors	High concentrations of interferences or analytes, inappropriate method	Accuracy Comparability Completeness	False negatives Poor accuracy Low sensitivity	Invalidation of samples with high dilution factors, may qualify sample results as estimated
Equipment Rinsate Blank	Contamination greater than the detection limit	Improper decontamination of field sampling equipment, contaminated rinsate water, containers, or preservatives	Accuracy Completeness Representativeness	False positives High bias	Invalidates all sample results where equipment blank contamination is greater than 5% of sample concentration
Field Quality Assurance Samples ⁴	Quality assurance sample results do not agree with project and/or QC sample results	Improper SOP (QA and primary laboratory used different analytical methods), inadequate cleanup, inadequate background correction, laboratory contamination, preservative problems, method failure, sample misidentification, samples were not homogeneous	Comparability Completeness Precision Representativeness	Non-representative sample False positives False negatives High or low bias	Qualifies or invalidates all or part of the data set
Field Quality Control Samples ⁵	Field and QC sample concentrations do not compare within acceptable limits	Samples were not homogeneous, insufficient mixing in the field, samples not split but collocated, insufficient mixing in laboratory	Precision Representativeness	Non-representative samples Poor precision High or low bias	Qualifies all sample results greater than detection limit (i.e., possible highly variable results), sample results less than detection limit are valid

QC Element	Type of Failure	Possible Cause ¹	Major PARCCs Affected ²	Possible Effect on Data	Possible Worst Case Data Evaluation Scenario ³
Headspace	Air bubbles in aqueous VOC vials; visible headspace in soil VOC container	Poor sampling technique, caps not sealed tight, septum caps not used, dirt between rim and cap, soil not packed tight, improper SOP	Accuracy Completeness Representativeness	False negatives Low bias	Invalidation of sample results
Holding Times ⁶	Holding times exceeded	Excessive analysis time, holding samples too long prior to shipment, shipping samples prior to a weekend or holiday, inappropriate shipping method	Accuracy Completeness Representativeness	False negatives Low bias	Invalidation of sample results, affects legal defensibility of data, sample results greater than detection limit considered as minimum values only
Matrix Spike and/or Matrix Spike Duplicate ⁷	High recoveries	Matrix effects, inappropriate method, method failure, inadequate cleanup, inadequate background correction, failure to use method of standard additions, improper spiking, degraded spiking solution, failed spiking device, contaminated reagents or glassware	Accuracy Precision	False positives High bias	Qualifies all sample results greater than detection limit (i.e., possible matrix effects)
	High relative percent difference	Sample is not homogeneous, inadequate sample mixing in laboratory, samples misidentified, method failure, improper spiking, degraded spiking solution, failed spiking device, contaminated reagents or glassware	Precision Representativeness	Non-representative sample Poor precision	Qualifies all sample results greater than the detection limit (i.e., possible highly variable results)
	Low recoveries	Matrix effects, inappropriate method, method failure, inadequate cleanup, inadequate background concentration, failure to use method of standard additions, improper spiking, degraded spiking solution, failed spiking device	Accuracy	False negatives Low bias	Qualifies all sample results (i.e., possible matrix effects)
	Matrix spike and/or matrix spike duplicate missing	Insufficient sample, lost during analysis, improper SOP	Accuracy Precision Representativeness	False negatives High or low bias	Qualifies all sample results (i.e., no measure of matrix effects)

Table 6: Data Evaluation

QC Element	Type of Failure	Possible Cause ¹	Major PARCCs Affected ²	Possible Effect on Data	Possible Worst Case Data Evaluation Scenario ³
Method Blank ⁸	Contamination greater than detection limit	Contaminated reagents or glassware, poor laboratory technique, improper SOP	Accuracy Completeness Representativeness	False positives High bias	Invalidates all sample results where method blank contamination is greater than 5% of sample concentration
	Method blank absent	Lost during analysis, improper SOP	Accuracy Completeness Representativeness	False negatives Low sensitivity	Invalidation of sample results greater than detection limit, sample results less than detection limit are valid
Preservation	No preservative or wrong pH	No preservative added, improper amount of preservative added, overfilling container with sample, improper SOP	Accuracy Completeness Representativeness	False negatives Low bias	Invalidation of sample results, affects legal defensibility of data, sample results greater than detection limit considered as minimum values only
	Samples not properly cooled, placed on ice	Insufficient ice used, shipping container not adequately insulated, transport time too long	Accuracy Completeness Representativeness	False negatives Low bias	Invalidation of sample results, affects legal defensibility of data, sample results greater than detection limit considered as minimum values only
	Wrong preservative	Improper SOP, failure to read SAP, SAP incorrect	Accuracy Completeness Representativeness	Incomplete data False positives False negatives	Invalidates or qualifies some or all of the sample results, affects legal defensibility of data
Sample Containers	Plastic containers used for organic analytes	Sampler unaware of requirements to use glass, SAP incorrect or not followed, improper SOP	Accuracy Completeness Representativeness	False positives False negatives High or low bias Phthalate interference	Invalidation of sample results

Table 6: Data Evaluation

QC Element	Type of Failure	Possible Cause ¹	Major PARCCs Affected ²	Possible Effect on Data	Possible Worst Case Data Evaluation Scenario ³
Sample Filtration	Samples not filtered and preserved in field for dissolved metals	Sampler error, sampler unaware of requirement, improper SOP, failure to read SAP, SAP incorrect, filtration apparatus not available or damaged	Accuracy Completeness Representativeness	False positives False negatives High or low bias	Invalidation of sample results for dissolved metals
Sample Labeling	Sample labels missing, not attached to containers, or illegible	Failure to protect sample containers from moisture, failure to use appropriate marker, improper SOP	Completeness Representativeness	Incomplete data False positives False negatives	Invalidation of sample results
	Samples mislabeled	Sample error, improper SOP	Completeness Representativeness	Incomplete data False positives False negatives	Invalidation of sample results
Surrogate Recoveries in Method Blank	High recoveries	Method failure, improper spiking, degraded spiking solution, failed spiking device, contaminated reagents or glassware	Accuracy Completeness	High bias Possible false positives	Invalidation of sample results
	Low recoveries	Method failure, improper spiking, degraded spiking solution, failed spiking device	Accuracy Completeness	False negatives Low bias	Invalidation of sample results
Surrogate Recoveries in Samples	High recoveries	Matrix effects, inappropriate method, method failure, improper spiking, degraded spiking solution, failed spiking device	Accuracy Completeness	False positives High bias	Qualifies all sample results (i.e., possible matrix effects), rejection of individual sample results
	Low recoveries	Matrix effects, inappropriate method, method failure, improper spiking, degraded spiking solution, failed spiking device	Accuracy Completeness	False negatives Low bias	Qualifies all sample results (i.e., possible matrix effects), rejection of individual sample results
Trip Blank (applies to volatile analysis only)	Contamination greater than detection limit	Cross-contamination during shipment or storage, contaminated reagent water, glassware, or preservative	Accuracy Completeness Representativeness	False positives High bias	Invalidates all sample results where trip blank contamination is greater than 5% of sample concentration

Table 6: Data Evaluation

QC Element	Type of Failure	Possible Cause ¹	Major PARCCs Affected ²	Possible Effect on Data	Possible Worst Case Data Evaluation Scenario ³
	Trip blank absent	Improper SOP, trip blank broken during shipment, trip blank lost during analysis	Accuracy Completeness Representativeness	False positives	Invalidation of sample results greater than detection limit, sample results less than detection limit are valid
<p>1 The most common possible causes are listed.</p> <p>2 PARCCs parameters most affected are listed. It is quite possible that other PARCCs are affected.</p> <p>3 All data evaluation must take into account the specific data quality objectives for a given project; therefore, it is possible that even suspect data may be used, depending upon the DQOs established for a project.</p> <p>4 Use of field QA sample data to evaluate project sample data assumes that the field QA sample data is supported by a complete set of in-control laboratory quality control data.</p> <p>5 Conventional sampling protocols for some analyte classes (VOCs, BTEX, GRO) prohibit sample mixing and splitting, because it results in the loss of major fractions of the analytes. Field and QC samples for these analytes are appropriately collected as collocated sample pairs.</p> <p>6 Generally, exceeding the holding times of a sample will result in false negatives and/or low bias; however, exceeding holding times on certain types of samples (carbonates, DO) may result in a false positive or high bias. Furthermore, high bias and false positives can occur when degradation products of contaminants are also themselves analytes.</p> <p>7 When native samples concentrations are significantly greater than the effective spike concentration then the conclusion of a matrix effect is only tentative. As a general rule, the native sample concentration should be no more than four times higher than the matrix spike concentration for the matrix effect to be considered probably present.</p> <p>8 Method blanks are not appropriate for all analytes (i.e., pH, conductivity, % solids, total suspended solids, etc.).</p> <p><i>Note that entries in the possible causes, PARCCs parameters affected, effect on data, and possible data evaluation columns assume that only type of failure occurred at any given time. The cumulative or synergistic effects of more than one failure type occurring at the same time make data evaluation more complex and is beyond the scope of this table.</i></p>					

Table 6: Data Evaluation

APPENDIX A: TYPICAL LIST OF CHEMICALS OF CONCERN

LUST Program Action Levels

Parameter	Groundwater		Soil	
TPH-GRO	n/a	DEP Action Level	100 mg/kg	DEP Action Level
TPH-GRO	n/a	DEP Action Level	100 mg/kg	DEP Action Level
TPH-ORO	n/a	DEP Action Level	100 mg/kg	DEP Action Level
Benzene	5.0 ug/l	46CSR12	50 ug/kg	DEP Action Level
Ethylbenzene	0.7 mg/l	46CSR12	n/a	-----
Toluene	1.0 mg/l	46CSR12	n/a	-----
Total Xylenes	10.0 mg/l	46CSR12	n/a	-----
Total BTEX	n/a	-----	10 mg/kg	DEP Action Level
Total PAHs	n/a	-----	1 mg/kg	DEP Action Level
MTBE	20.0 ug/l	DEP Action Level	n/a	-----
Naphthalene	20.0 ug/l	Health Based Limit	n/a	-----
Dissolved Lead	15.0 ug/l	46CSR12	n/a	-----
Note: Those limits set by WV CSR Title 46, Series 12, <i>The Requirements Governing Groundwater Standards</i> , are set by the WV Legislature and, as such, cannot be deviated from. However, those limits that are DEP Action Levels are guidance concentrations used by OER and can be adjusted based on site conditions, as needed.				

Voluntary Remediation Program De Minimis Table (Table 60-3B)

(effective June 1, 2014)

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Acetaldehyde	75-07-0	1.0E+01	c	3.7E+02	nc	2.2E+00	c	8.9E-03
Acetochlor	34256-82-1	1.2E+03	nc	1.8E+04	nc	3.1E+02	nc	5.0E+00
Acetone	67-64-1	6.1E+04	nc	1.1E+05	Csat	1.2E+04	nc	4.7E+01
Acetonitrile	75-05-8	8.7E+02	nc	3.7E+03	nc	1.2E+02	nc	5.2E-01
Acetophenone	98-86-2	2.5E+03	Csat	2.5E+03	Csat	1.6E+03	nc	9.5E+00
Acrolein	107-02-8	1.6E-01	nc	6.6E-01	nc	4.1E-02	nc	1.7E-04
Acrylamide	79-06-1	2.3E-01	c	4.9E+01	c	4.3E-02	c	1.8E-04
Acrylonitrile	107-13-1	2.4E-01	c	1.3E+01	c	4.5E-02	c	2.0E-04
Alachlor	15972-60-8	8.7E+00	c	4.4E+02	c	2.0E+00	gws	3.3E-02
Alar	1596-84-5	2.7E+01	c	1.4E+03	c	3.7E+00	c	1.6E-02
Aldicarb	116-06-3	6.1E+01	nc	8.8E+02	nc	1.6E+01	nc	7.8E-02
Aldicarb sulfone	1646-88-4	6.1E+01	nc	8.8E+02	nc	1.6E+01	nc	6.9E-02
Aldrin	309-00-2	2.9E-02	c	1.5E+00	c	4.0E-03	c	1.3E-02
Aluminum	7429-90-5	7.7E+04	nc	1.0E+06	max	1.6E+04	nc	4.7E+05
Aniline	62-53-3	8.5E+01	c	4.3E+03	c	1.2E+01	c	8.0E-02
Antimony and compounds	7440-36-0	3.1E+01	nc	8.2E+02	nc	6.3E+00	nc	5.7E+00
Arsenic	7440-38-2	3.9E-01	c	2.7E+01	c	1.0E+01	gws	5.8E+00
Assure	76578-14-8	5.5E+02	nc	7.9E+03	nc	1.4E+02	nc	4.4E+01
Atrazine	1912-24-9	2.1E+00	c	1.1E+02	c	3.0E+00	gws	3.9E-02
Azobenzene	103-33-3	5.2E+00	c	4.2E+02	c	1.2E-01	c	1.9E-02
Barium and compounds	7440-39-3	1.5E+04	nc	3.6E+05	nc	2.0E+03	gws	1.6E+03
Baygon	114-26-1	2.4E+02	nc	3.5E+03	nc	6.3E+01	nc	4.0E-01
Baythroid	68359-37-5	1.5E+03	nc	2.2E+04	nc	3.9E+02	nc	2.1E+03
Bentazon	25057-89-0	1.8E+03	nc	2.6E+04	nc	4.7E+02	nc	2.1E+00

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Benzaldehyde	100-52-7	1.2E+03	Csat	1.2E+03	Csat	5.0E+02	nc	2.2E+00
Benzene	71-43-2	1.1E+00	c	5.7E+01	c	5.0E+00	gws	5.1E-02
Benzidine	92-87-5	5.0E-04	c	1.1E-01	c	9.4E-05	c	4.8E-06
Benzoic acid	65-85-0	2.4E+05	nc	1.0E+06	max	6.3E+04	nc	2.9E+02
Benzyl alcohol	100-51-6	6.1E+03	nc	8.8E+04	nc	1.6E+03	nc	7.6E+00
Benzyl chloride	100-44-7	1.0E+00	c	5.7E+01	c	7.9E-02	c	1.7E-03
Beryllium and compounds	7440-41-7	1.6E+02	nc	3.9E+03	nc	4.0E+00	gws	6.3E+01
1,1-Biphenyl	92-52-4	5.1E+01	nc	2.2E+02	nc	8.3E-01	nc	1.7E-01
Bis(2-chloroethyl)ether	111-44-4	2.1E-01	c	1.3E+01	c	1.2E-02	c	6.3E-05
Bis(2-chloroisopropyl)ether	108-60-1	4.6E+00	c	3.0E+02	c	3.2E-01	c	2.4E-03
Bis(chloromethyl)ether	542-88-1	7.8E-05	c	4.0E-03	c	6.2E-05	c	2.9E-07
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	3.5E+01	c	1.8E+03	c	6.0E+00	gws	2.9E+01
Bromodichloromethane	75-27-4	2.8E-01	c	1.4E+01	c	1.2E-01	c	6.4E-04
Bromoform (tribromomethane)	75-25-2	6.1E+01	c	3.1E+03	c	8.5E+00	c	4.5E-02
Bromomethane	74-83-9	7.4E+00	nc	3.3E+01	nc	7.1E+00	nc	3.6E-02
Bromophos	2104-96-3	3.1E+02	nc	4.4E+03	nc	7.8E+01	nc	6.6E+00
1,3-Butadiene	106-99-0	5.4E-02	c	3.1E+00	c	1.8E-02	c	1.9E-04
1-Butanol	71-36-3	6.1E+03	nc	8.8E+04	nc	1.6E+03	nc	6.5E+00
Butylate	2008-41-5	3.1E+03	nc	4.4E+04	nc	7.8E+02	nc	1.5E+01
n-Butylbenzene	104-51-8	1.1E+02	Csat	1.1E+02	Csat	7.8E+02	nc	5.0E+01
Butyl benzyl phthalate	85-68-7	2.6E+02	c	1.3E+04	c	3.5E+01	c	1.0E+01
Cadmium and compounds	7440-43-9	3.7E+01	nc	8.0E+02	nc	5.0E+00	gws	7.5E+00
Caprolactam	105-60-2	3.1E+04	nc	4.4E+05	nc	7.8E+03	nc	3.9E+01
Carbaryl	63-25-2	6.1E+03	nc	8.8E+04	nc	1.6E+03	nc	2.8E+01
Carbon disulfide	75-15-0	7.4E+02	Csat	7.4E+02	Csat	7.6E+02	nc	4.5E+00
Carbon tetrachloride	56-23-5	6.1E-01	c	3.2E+01	c	5.0E+00	gws	3.9E-02
Carbosulfan	55285-14-8	6.1E+02	nc	8.8E+03	nc	1.6E+02	nc	7.6E+01

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Chloranil	118-75-2	1.2E+00	c	6.1E+01	c	1.7E-01	c	2.7E-03
Chlordane (Technical)	12789-03-6	1.6E+00	c	1.1E+02	c	2.0E+00	gws	2.7E+00
Chloroacetic acid	79-11-8	1.2E+02	nc	1.8E+03	nc	3.1E+01	nc	1.3E-01
4-Chloroaniline	106-47-8	2.4E+00	c	1.2E+02	c	3.4E-01	c	2.9E-03
Chlorobenzene	108-90-7	3.0E+02	nc	7.6E+02	Csat	1.0E+02	gws	1.4E+00
Chlorobenzilate	510-15-6	4.4E+00	c	2.2E+02	c	6.1E-01	c	4.0E-02
p-Chlorobenzoic acid	74-11-3	1.8E+03	nc	2.6E+04	nc	4.7E+02	nc	2.4E+00
2-Chloro-1,3-butadiene	126-99-8	9.5E-03	c	4.8E-01	c	1.6E-02	c	1.7E-04
1-Chlorobutane	109-69-3	2.6E+02	nc	7.3E+02	Csat	2.0E+02	nc	1.6E+00
Chloroethane	75-00-3	2.1E+03	Csat	2.1E+03	Csat	2.1E+04	nc	1.2E+02
Chloroform	67-66-3	3.0E-01	c	1.5E+01	c	1.9E-01	c	1.1E-03
Chloromethane	74-87-3	1.2E+02	nc	5.1E+02	nc	1.9E+02	nc	9.8E-01
4-Chloro-2-methylaniline	95-69-2	4.9E+00	c	2.5E+02	c	6.7E-01	c	7.7E-03
beta-Chloronaphthalene	91-58-7	5.0E+03	nc	6.4E+04	nc	4.0E+02	nc	4.1E+01
o-Chloronitrobenzene	88-73-3	2.1E+00	c	1.9E+02	c	2.2E-01	c	4.2E-03
p-Chloronitrobenzene	100-00-5	7.8E+01	nc	2.0E+03	nc	1.1E+01	c	2.0E-01
2-Chlorophenol	95-57-8	3.4E+02	nc	5.1E+03	nc	2.5E+01	nc	4.1E-01
o-Chlorotoluene	95-49-8	4.6E+02	nc	9.1E+02	Csat	1.0E+02	nc	1.9E+00
Chlorpyrifos-methyl	5598-13-0	6.1E+02	nc	8.8E+03	nc	1.6E+02	nc	1.4E+01
Chromium III	16065-83-1	1.2E+05	nc	1.0E+06	max	2.3E+04	nc	8.4E+08
Chromium VI	18540-29-9	3.0E-01	c	1.1E+02	c	4.3E-02	c	1.7E-02
Cobalt	7440-48-4	2.3E+01	nc	6.0E+02	nc	4.7E+00	nc	4.2E+00
Copper and compounds	7440-50-8	3.1E+03	nc	8.2E+04	nc	6.3E+02	nc	4.4E+02
Crotonaldehyde	123-73-9	7.2E-02	c	4.0E+00	c	7.1E-03	c	2.9E-05
Cyanazine	21725-46-2	5.8E-01	c	2.9E+01	c	8.0E-02	c	7.5E-04
Cyanide and compounds	74-90-8	4.6E+00	nc	2.1E+01	nc	2.0E+02	gws	4.0E+01
Cyanogen	460-19-5	7.8E+01	nc	1.5E+03	Csat	1.6E+01	nc	7.0E-02

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Cyanogen bromide	506-68-3	7.0E+03	nc	1.0E+05	Csat	1.4E+03	nc	8.4E+00
Cyclohexane	110-82-7	1.2E+02	Csat	1.2E+02	Csat	1.2E+04	nc	2.6E+02
Cyclohexanone	108-94-1	3.1E+05	nc	1.0E+06	max	7.8E+04	nc	3.7E+02
Cyhalothrin/Karate	68085-85-8	3.1E+02	nc	4.4E+03	nc	7.8E+01	nc	1.1E+03
Cypermethrin	52315-07-8	6.1E+02	nc	8.8E+03	nc	1.6E+02	nc	5.0E+02
Dacthal	1861-32-1	6.1E+02	nc	8.8E+03	nc	1.6E+02	nc	3.8E+00
Dalapon	75-99-0	1.8E+03	nc	2.6E+04	nc	2.0E+02	gws	8.3E-01
DDD	72-54-8	2.0E+00	c	1.0E+02	c	2.8E-01	c	1.3E+00
DDE	72-55-9	1.4E+00	c	7.3E+01	c	2.0E-01	c	9.3E-01
DDT	50-29-3	1.7E+00	c	1.2E+02	c	2.0E-01	c	1.3E+00
Diazinon	333-41-5	4.3E+01	nc	6.2E+02	nc	1.1E+01	nc	1.4E+00
Dibenzofuran	132-64-9	7.8E+01	nc	2.0E+03	nc	1.6E+01	nc	5.8E+00
1,4-Dibromobenzene	106-37-6	6.1E+02	nc	8.8E+03	nc	1.6E+02	nc	3.0E+00
Dibromochloromethane	124-48-1	5.8E+00	c	2.9E+02	c	8.0E-01	c	4.3E-03
1,2-Dibromo-3-chloropropane	96-12-8	1.9E-01	c	7.1E+01	c	2.0E-01	gws	1.7E-03
1,2-Dibromoethane	106-93-4	3.4E-02	c	1.8E+00	c	5.0E-02	gws	2.8E-04
Dibutyl phthalate	84-74-2	6.1E+03	nc	8.8E+04	nc	1.6E+03	nc	7.9E+01
Dicamba	1918-00-9	1.8E+03	nc	2.6E+04	nc	4.7E+02	nc	2.4E+00
1,2-Dichlorobenzene	95-50-1	3.8E+02	Csat	3.8E+02	Csat	6.0E+02	gws	1.2E+01
1,4-Dichlorobenzene	106-46-7	2.7E+00	c	1.4E+02	c	7.5E+01	gws	1.4E+00
3,3-Dichlorobenzidine	91-94-1	1.1E+00	c	5.5E+01	c	1.5E-01	c	2.0E-02
1,4-Dichloro-2-butene	764-41-0	6.6E-03	c	3.3E-01	c	1.2E-03	c	1.1E-05
Dichlorodifluoromethane	75-71-8	1.9E+02	nc	8.0E+02	nc	3.7E+02	nc	1.1E+01
1,1-Dichloroethane	75-34-3	3.3E+00	c	1.7E+02	c	2.4E+00	c	1.4E-02
1,2-Dichloroethane	107-06-2	4.4E-01	c	2.3E+01	c	5.0E+00	gws	2.8E-02
1,1-Dichloroethylene	75-35-4	2.4E+02	nc	1.1E+03	nc	7.0E+00	gws	5.0E-02
1,2-Dichloroethylene (cis)	156-59-2	1.8E+01	nc	8.2E+01	nc	7.0E+01	gws	4.1E-01

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
1,2-Dichloroethylene (trans)	156-60-5	1.5E+02	nc	7.0E+02	nc	1.0E+02	gws	5.9E-01
2,4-Dichlorophenol	120-83-2	1.8E+02	nc	2.6E+03	nc	4.7E+01	nc	1.1E+00
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	94-82-6	4.9E+02	nc	7.0E+03	nc	1.3E+02	nc	9.9E-01
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	6.9E+02	nc	1.2E+04	nc	7.0E+01	gws	3.6E-01
1,2-Dichloropropane	78-87-5	9.0E-01	c	4.7E+01	c	5.0E+00	gws	3.3E-02
1,3-Dichloropropene	542-75-6	1.7E+00	c	9.5E+01	c	4.3E-01	c	3.1E-03
2,3-Dichloropropanol	616-23-9	1.8E+02	nc	2.6E+03	nc	4.7E+01	nc	2.0E-01
Dichlorvos	62-73-7	1.7E+00	c	8.5E+01	c	2.3E-01	C	1.4E-03
Dicyclopentadiene	77-73-6	2.7E+01	nc	1.2E+02	nc	1.3E+01	nc	9.0E-01
Dieldrin	60-57-1	3.0E-02	c	1.5E+00	c	4.2E-03	c	3.4E-03
Diethylene glycol, monobutyl ether	112-34-5	1.8E+03	nc	2.5E+04	nc	4.7E+02	nc	2.1E+00
Diethylene glycol, monoethyl ether	111-90-0	3.6E+03	nc	5.1E+04	nc	9.4E+02	nc	3.8E+00
Di(2-ethylhexyl)adipate	103-23-1	4.0E+02	c	2.1E+04	c	4.0E+02	gws	5.8E+02
Diethyl phthalate	84-66-2	4.9E+04	nc	7.0E+05	nc	1.3E+04	nc	1.0E+02
Diethylstilbestrol	56-53-1	1.4E-03	c	7.0E-02	c	1.9E-04	c	2.1E-03
Difenzoquat (Avenge)	43222-48-6	4.9E+03	nc	7.0E+04	nc	1.3E+03	nc	3.9E+03
1,1-Difluoroethane	75-37-6	1.4E+03	Csat	1.4E+03	Csat	8.3E+04	nc	5.6E+02
Diisopropyl methylphosphonate	1445-75-6	5.3E+02	Csat	5.3E+02	Csat	1.3E+03	nc	7.1E+00
3,3'-Dimethoxybenzidine	119-90-4	3.5E+01	c	1.8E+03	c	4.8E+00	c	1.2E-01
N-N-Dimethylaniline	121-69-7	9.6E+01	nc	8.3E+02	Csat	1.0E+01	nc	7.1E-02
2,4-Dimethylaniline	95-68-1	2.4E+00	c	1.2E+02	c	3.4E-01	c	3.8E-03
2,4-Dimethylaniline hydrochloride	21436-96-4	8.4E-01	c	4.3E+01	c	1.2E-01	c	1.3E-03
3,3'-Dimethylbenzidine	119-93-7	4.4E-02	c	2.2E+00	c	6.1E-03	c	8.0E-04
2,4-Dimethylphenol	105-67-9	1.2E+03	nc	1.8E+04	nc	3.1E+02	nc	7.4E+00
2,6-Dimethylphenol	576-26-1	3.7E+01	nc	5.3E+02	nc	9.4E+00	nc	2.3E-01
3,4-Dimethylphenol	95-65-8	6.1E+01	nc	8.8E+02	nc	1.6E+01	nc	3.7E-01
4,6-Dinitro-o-cyclohexyl phenol	131-89-5	1.2E+02	nc	1.8E+03	nc	3.1E+01	nc	2.1E+01

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
1,2-Dinitrobenzene	528-29-0	6.1E+00	nc	8.8E+01	nc	1.6E+00	nc	2.9E-02
1,3-Dinitrobenzene	99-65-0	6.1E+00	nc	8.8E+01	nc	1.6E+00	nc	2.8E-02
1,4-Dinitrobenzene	100-25-4	6.1E+00	nc	8.8E+01	nc	1.6E+00	nc	2.8E-02
2,4-Dinitrophenol	51-28-5	1.2E+02	nc	1.8E+03	nc	3.1E+01	nc	7.0E-01
Dinitrotoluene mixture	25321-14-6	7.1E-01	c	3.6E+01	c	9.9E-02	c	2.7E-03
2,4-Dinitrotoluene	121-14-2	1.6E+00	c	8.0E+01	c	2.2E-01	c	5.9E-03
2,6-Dinitrotoluene	606-20-2	6.1E+01	nc	8.9E+02	nc	1.6E+01	nc	4.3E-01
Dinoseb	88-85-7	6.1E+01	nc	8.8E+02	nc	7.0E+00	gws	1.2E+00
1,4-Dioxane	123-91-1	4.9E+00	c	2.5E+02	c	6.7E-01	c	2.8E-03
Diphenylamine	122-39-4	1.5E+03	nc	2.2E+04	nc	3.9E+02	nc	1.4E+01
1,2-Diphenylhydrazine	122-66-7	6.1E-01	c	3.1E+01	c	8.4E-02	c	5.4E-03
Diquat	85-00-7	1.3E+02	nc	1.9E+03	nc	2.0E+01	gws	7.5E+00
Disulfoton	298-04-4	2.4E+00	nc	3.5E+01	nc	6.3E-01	nc	2.3E-02
1,4-Dithiane	505-29-3	5.3E+02	nc	5.3E+03	nc	5.0E+01	nc	4.9E-01
Diuron	330-54-1	1.2E+02	nc	1.8E+03	nc	3.1E+01	nc	2.6E-01
Endosulfan	115-29-7	3.7E+02	nc	5.3E+03	nc	9.4E+01	nc	2.6E+01
Endothall	145-73-3	1.2E+03	nc	1.8E+04	nc	1.0E+02	gws	4.8E-01
Endrin	72-20-8	1.8E+01	nc	2.6E+02	nc	2.0E+00	gws	1.6E+00
Epichlorohydrin	106-89-8	2.0E+01	nc	8.9E+01	nc	2.0E+00	nc	9.0E-03
Ethion	563-12-2	3.1E+01	nc	4.4E+02	nc	7.8E+00	nc	3.1E-01
2-Ethoxyethanol	110-80-5	2.4E+04	nc	3.5E+05	nc	6.3E+03	nc	2.5E+01
Ethyl acetate	141-78-6	1.1E+04	Csat	1.1E+04	Csat	4.5E+03	nc	1.9E+01
Ethylbenzene	100-41-4	5.4E+00	c	2.9E+02	c	7.0E+02	gws	1.6E+01
Ethylene diamine	107-15-3	5.5E+03	nc	7.9E+04	nc	1.4E+03	nc	6.5E+00
Ethylene glycol	107-21-1	1.2E+05	nc	1.0E+06	max	3.1E+04	nc	1.3E+02
Ethylene glycol, monobutyl ether	111-76-2	6.1E+03	nc	8.8E+04	nc	1.6E+03	nc	6.4E+00
Ethylene thiourea (ETU)	96-45-7	4.9E+00	nc	7.0E+01	nc	1.3E+00	nc	5.7E-03

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Ethyl ether	60-29-7	2.1E+03	nc	1.0E+04	Csat	1.0E+03	nc	4.5E+00
Ethyl methacrylate	97-63-2	1.1E+03	Csat	1.1E+03	Csat	4.3E+02	nc	2.0E+00
Fenamiphos	22224-92-6	1.5E+01	nc	2.2E+02	nc	3.9E+00	nc	7.8E-02
Fluometuron	2164-17-2	7.9E+02	nc	1.1E+04	nc	2.0E+02	nc	3.1E+00
Fluoride	7782-41-4	4.7E+03	nc	1.2E+05	nc	4.0E+03	gws	1.2E+04
Fomesafen	72178-02-0	2.6E+00	c	1.3E+02	c	3.5E-01	c	2.3E-02
Fonofos	944-22-9	1.2E+02	nc	1.8E+03	nc	3.1E+01	nc	1.2E+00
Formaldehyde	50-00-0	1.2E+04	nc	1.8E+05	nc	3.1E+03	nc	1.3E+01
Formic Acid	64-18-6	4.9E+04	nc	5.4E+05	nc	1.4E+04	nc	5.7E+01
Furan	110-00-9	9.1E+00	nc	4.3E+01	nc	5.0E+00	nc	3.8E-02
Furazolidone	67-45-8	1.3E-01	c	6.5E+00	c	1.8E-02	c	6.8E-04
Furfural	98-01-1	1.8E+02	nc	2.6E+03	nc	4.7E+01	nc	2.0E-01
Glycidaldehyde	765-34-4	2.4E+01	nc	3.5E+02	nc	6.3E+00	nc	2.5E-02
Glyphosate	1071-83-6	6.1E+03	nc	8.8E+04	nc	7.0E+02	gws	2.8E+00
Heptachlor	76-44-8	1.1E-01	c	5.5E+00	c	4.0E-01	gws	6.6E-01
Heptachlor epoxide	1024-57-3	5.3E-02	c	2.7E+00	c	2.0E-01	gws	8.2E-02
Hexabromobenzene	87-82-1	1.2E+02	nc	1.8E+03	nc	3.1E+01	nc	3.6E+00
Hexachlorobenzene	118-74-1	3.0E-01	c	1.5E+01	c	1.0E+00	gws	2.5E-01
Hexachlorobutadiene	87-68-3	6.2E+00	c	3.2E+02	c	8.6E-01	c	3.3E-02
HCH (alpha)	319-84-6	7.7E-02	c	3.9E+00	c	1.1E-02	c	1.2E-03
HCH (beta)	319-85-7	2.7E-01	c	1.4E+01	c	3.7E-02	c	4.3E-03
HCH (gamma) Lindane	58-89-9	5.2E-01	c	3.4E+01	c	2.0E-01	gws	2.3E-02
HCH-technical	608-73-1	2.7E-01	c	1.4E+01	c	3.7E-02	c	4.3E-03
Hexachlorocyclopentadiene	77-47-4	3.7E+02	nc	5.3E+03	nc	5.0E+01	gws	3.1E+00
Hexachlorodibenzo-p-dioxin mixture (HxCDD)	19408-74-3	9.4E-05	c	6.6E-03	c	1.1E-05	c	3.0E-04
Hexachloroethane	67-72-1	1.2E+01	c	6.2E+02	c	1.7E+00	c	2.0E-02
Hexachlorophene	70-30-4	1.8E+01	nc	2.6E+02	nc	4.7E+00	nc	1.3E+02

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
1,6-Hexamethylene diisocyanate	822-06-0	3.4E+00	nc	1.4E+01	nc	2.1E-02	nc	4.1E-03
n-Hexane	110-54-3	1.4E+02	Csat	1.4E+02	Csat	5.7E+02	nc	8.0E+01
Hexazinone	51235-04-2	2.0E+03	nc	2.9E+04	nc	5.2E+02	nc	4.7E+00
HMX	2691-41-0	3.8E+03	nc	9.5E+04	nc	7.8E+02	nc	2.0E+01
Hydrazine	302-01-2	2.1E-01	c	1.9E+01	c	2.2E-02	c	9.1E-05
Hydrogen sulfide	7783-06-4	1.8E+00	nc	7.5E+00	nc	4.2E+00	nc	
p-Hydroquinone	123-31-9	8.1E+00	C	4.1E+02	c	1.1E+00	c	1.5E-02
Iron	7439-89-6	5.5E+04	nc	1.0E+06	max	1.1E+04	nc	5.5E+03
Isobutanol	78-83-1	2.3E+04	nc	6.1E+05	nc	4.7E+03	nc	1.9E+01
Isophorone	78-59-1	5.1E+02	c	2.6E+04	c	7.1E+01	c	4.7E-01
Isopropalin	33820-53-0	9.2E+02	nc	1.3E+04	nc	2.3E+02	nc	1.1E+02
Isopropylbenzene (Cumene)	98-82-8	2.7E+02	Csat	2.7E+02	Csat	5.4E+02	nc	1.8E+01
Isopropyl methyl phosphonic acid	1832-54-8	6.1E+03	nc	8.8E+04	nc	1.6E+03	nc	6.7E+00
Lead*	7439-92-1	4.0E+02	nc	1.0E+03	nc	1.5E+01	gws	2.7E+02
Lead (tetraethyl)	78-00-2	6.1E-03	nc	8.8E-02	nc	1.6E-03	nc	1.1E-04
Lithium	7439-93-2	1.6E+02	nc	4.1E+03	nc	3.1E+01	nc	1.9E+02
Malathion	121-75-5	1.2E+03	nc	1.8E+04	nc	3.1E+02	nc	1.6E+00
Maleic anhydride	108-31-6	6.1E+03	nc	8.6E+04	nc	1.6E+03	nc	6.3E+00
Manganese (non-food)	7439-96-5	3.5E+03	nc	7.2E+04	nc	7.4E+02	nc	9.6E+02
Mephosfolan	950-10-7	5.5E+00	nc	7.9E+01	nc	1.4E+00	nc	4.1E-02
Mepiquat	24307-26-4	1.8E+03	nc	2.6E+04	nc	4.7E+02	nc	3.1E+00
Mercury (elemental and inorganic)	7439-97-6	2.3E+01	nc	6.1E+02	nc	2.0E+00	gws	2.1E+00
Mercury (methyl)	22967-92-6	7.8E+00	nc	2.0E+02	nc	1.6E+00	nc	
Methacrylonitrile	126-98-7	7.6E+00	nc	1.7E+02	nc	1.5E+00	nc	6.9E-03
Methanol	67-56-1	3.1E+04	nc	4.4E+05	nc	7.8E+03	nc	3.2E+01
Methidathion	950-37-8	6.1E+01	nc	8.8E+02	nc	1.6E+01	nc	7.6E-02
Methoxychlor	72-43-5	3.1E+02	nc	4.4E+03	nc	4.0E+01	gws	4.3E+01

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Methyl acetate	79-20-9	2.3E+04	nc	2.9E+04	Csat	5.0E+03	nc	2.1E+01
Methyl acrylate	96-33-3	8.3E+02	nc	3.5E+03	nc	2.2E+02	nc	9.3E-01
Methyl Tertiary Butyl Ether (MTBE)	1634-04-4	4.4E+01	c	2.3E+03	C	1.2E+01	c	5.6E-02
2-Methylaniline (o-toluidine)	95-53-4	2.0E+00	c	1.0E+02	c	2.8E-01	c	2.4E-03
2-Methyl-4-chlorophenoxyacetic acid	94-74-6	3.1E+01	nc	4.4E+02	nc	7.8E+00	nc	4.1E-02
4-(2-Methyl-4-chlorophenoxy) butyric acid	94-81-5	6.1E+02	nc	8.8E+03	nc	1.6E+02	nc	1.2E+00
2-(2-Methyl-4-chlorophenoxy) propionic acid	93-65-2	6.1E+01	nc	8.8E+02	nc	1.6E+01	nc	9.3E-02
4,4'-Methylenebisbenzeneamine	101-77-9	3.0E-01	c	1.5E+01	c	4.2E-02	c	3.7E-03
4,4'-Methylene bis(2-chloroaniline)	101-14-4	1.2E+00	c	2.5E+02	c	2.2E-01	c	5.0E-02
4,4'-Methylene bis(N,N'-dimethyl)aniline	101-61-1	1.1E+01	c	5.4E+02	c	1.5E+00	c	1.6E-01
Methylene bromide	74-95-3	2.5E+01	nc	1.1E+02	nc	7.9E+00	nc	3.9E-02
Methylene chloride	75-09-2	5.6E+01	c	3.3E+03	Csat	5.0E+00	gws	2.6E-02
4,4'-Methylenediphenyl isocyanate	101-68-8	8.2E+05	nc	1.0E+06	max			
Methyl ethyl ketone	78-93-3	2.8E+04	nc	2.8E+04	Csat	4.9E+03	nc	2.1E+01
Methyl isobutyl ketone	108-10-1	3.4E+03	Csat	3.4E+03	Csat	1.0E+03	nc	4.7E+00
Methyl methacrylate	80-62-6	2.4E+03	Csat	2.4E+03	Csat	1.4E+03	nc	6.0E+00
2-Methyl-5-nitroaniline	99-55-8	5.4E+01	c	2.7E+03	c	7.5E+00	c	8.3E-02
Methyl parathion	298-00-0	1.5E+01	nc	2.2E+02	nc	3.9E+00	nc	1.3E-01
2-Methylphenol	95-48-7	3.1E+03	nc	4.4E+04	nc	7.8E+02	nc	1.3E+01
3-Methylphenol (Cresol)	108-39-4	3.1E+03	nc	4.4E+04	nc	7.8E+02	nc	1.3E+01
4-Methylphenol	106-44-5	6.1E+03	nc	8.8E+04	nc	1.6E+03	nc	2.5E+01
Methyl styrene (mixture)	25013-15-4	2.5E+02	nc	3.8E+02	Csat	4.4E+01	nc	1.4E+00
Methyl styrene (alpha)	98-83-9	5.0E+02	Csat	5.0E+02	Csat	1.1E+03	nc	3.5E+01
Metolaclor (Dual)	51218-45-2	9.2E+03	nc	1.3E+05	nc	2.3E+03	nc	5.5E+01
Metribuzin	21087-64-9	1.5E+03	nc	2.2E+04	nc	3.9E+02	nc	2.4E+00
Mirex	2385-85-5	2.7E-02	c	1.4E+00	c	3.7E-03	c	5.3E-02
Molybdenum	7439-98-7	3.9E+02	nc	1.0E+04	nc	7.8E+01	nc	3.2E+01

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Monochloramine	10599-90-3	7.8E+03	nc	2.0E+05	nc	1.6E+03	nc	
Naled	300-76-5	1.2E+02	nc	1.8E+03	nc	3.1E+01	nc	2.8E-01
Nickel and compounds	7440-02-0	1.5E+03	nc	3.8E+04	nc	3.1E+02	nc	4.1E+02
Nitrate	14797-55-8	1.3E+05	nc	1.0E+06	max	1.0E+04	gws	
Nitrite	14797-65-0	7.8E+03	nc	2.0E+05	nc	1.0E+03	gws	
2-Nitroaniline	88-74-4	6.1E+02	nc	8.5E+03	nc	1.6E+02	nc	1.3E+00
Nitrobenzene	98-95-3	4.8E+00	c	2.4E+02	c	1.2E-01	c	1.6E-03
Nitrofurantoin	67-20-9	4.3E+03	nc	6.2E+04	nc	1.1E+03	nc	9.5E+00
Nitrofurazone	59-87-0	3.7E-01	c	1.9E+01	c	5.2E-02	c	9.3E-04
Nitroglycerin	55-63-0	6.1E+00	nc	8.8E+01	nc	1.6E+00	nc	1.4E-02
2-Nitropropane	79-46-9	1.3E-02	c	6.5E-01	c	1.8E-03	c	9.5E-06
N-Nitrosodi-n-butylamine	924-16-3	8.7E-02	c	6.4E+00	c	2.4E-03	c	9.9E-05
N-Nitrosodiethanolamine	1116-54-7	1.7E-01	c	8.8E+00	c	2.4E-02	c	9.7E-05
N-Nitrosodiethylamine	55-18-5	7.7E-04	c	1.6E-01	c	1.4E-04	c	1.1E-06
N-Nitrosodimethylamine	62-75-9	2.3E-03	c	4.8E-01	c	4.2E-04	c	2.1E-06
N-Nitrosodiphenylamine	86-30-6	9.9E+01	c	5.0E+03	c	1.4E+01	c	1.5E+00
N-Nitroso di-n-propylamine	621-64-7	6.9E-02	c	3.5E+00	c	9.6E-03	c	1.4E-04
N-Nitroso-N-methylethylamine	10595-95-6	2.2E-02	c	1.1E+00	c	3.1E-03	c	1.8E-05
N-Nitrosopyrrolidine	930-55-2	2.3E-01	c	1.2E+01	c	3.2E-02	c	2.5E-04
m-Nitrotoluene	99-08-1	6.1E+00	nc	8.8E+01	nc	1.6E+00	nc	2.9E-02
o-Nitrotoluene	88-72-2	2.9E+00	c	2.6E+02	c	3.1E-01	c	5.8E-03
p-Nitrotoluene	99-99-0	3.0E+01	c	1.5E+03	c	4.2E+00	c	7.8E-02
NuStar	85509-19-9	4.3E+01	nc	6.2E+02	nc	1.1E+01	nc	3.6E+01
Oryzalin	19044-88-3	3.1E+03	nc	4.4E+04	nc	7.8E+02	nc	2.9E+01
Oxadiazon	19666-30-9	3.1E+02	nc	4.4E+03	nc	7.8E+01	nc	1.6E+01
Oxamyl	23135-22-0	1.5E+03	nc	2.2E+04	nc	2.0E+02	gws	8.8E-01
Oxyfluorfen	42874-03-3	1.8E+02	nc	2.6E+03	nc	4.7E+01	nc	7.5E+01

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Paraquat dichloride	1910-42-5	2.7E+02	nc	4.0E+03	nc	7.0E+01	nc	1.9E+01
Parathion	56-38-2	3.7E+02	nc	5.3E+03	nc	9.4E+01	nc	9.5E+00
Pentachlorobenzene	608-93-5	4.9E+01	nc	7.0E+02	nc	1.3E+01	nc	1.9E+00
Pentachloronitrobenzene	82-68-8	1.9E+00	c	9.5E+01	c	2.6E-01	c	6.3E-02
Pentachlorophenol	87-86-5	8.9E-01	c	3.3E+01	c	1.0E+00	gws	2.0E-01
Perchlorate	7790-98-9	5.5E+01	nc	1.4E+03	nc	1.1E+01	nc	
Permethrin	52645-53-1	3.1E+03	nc	4.4E+04	nc	7.8E+02	nc	3.7E+03
Phenol	108-95-2	1.8E+04	nc	2.6E+05	nc	4.7E+03	nc	5.4E+01
m-Phenylenediamine	108-45-2	3.7E+02	nc	5.3E+03	nc	9.4E+01	nc	5.0E-01
p-Phenylenediamine	106-50-3	1.2E+04	nc	1.7E+05	nc	3.0E+03	nc	1.6E+01
2-Phenylphenol	90-43-7	2.5E+02	c	1.3E+04	c	3.5E+01	c	9.5E+00
Phosphine	7803-51-2	2.3E+01	nc	6.1E+02	nc	4.7E+00	nc	
Phosphorus (white)	7723-14-0	1.6E+00	nc	4.1E+01	nc	3.1E-01	nc	2.3E-02
p-Phthalic acid	100-21-0	6.1E+04	nc	8.8E+05	nc	1.6E+04	nc	1.1E+02
Phthalic anhydride	85-44-9	1.2E+05	nc	1.0E+06	max	3.1E+04	nc	1.4E+02
Polybrominated biphenyls	59536-65-1	1.6E-02	c	8.2E-01	c	2.2E-03	c	
Polychlorinated biphenyls (PCBs)	1336-36-3	2.2E-01	c	9.8E+00	c	5.0E-01	gws	9.0E-01
Aroclor 1016	12674-11-2	3.9E+00	nc	5.0E+01	nc	9.6E-01	c	1.8E+00
Aroclor 1221	11104-28-2	1.8E-01	c	1.2E+01	c	6.8E-03	c	2.3E-03
Aroclor 1232	11141-16-5	1.8E-01	c	1.2E+01	c	6.8E-03	c	2.3E-03
Aroclor 1242	53469-21-9	2.2E-01	c	1.0E+01	c	3.4E-02	c	1.1E-01
Aroclor 1248	12672-29-6	2.2E-01	c	1.0E+01	c	3.4E-02	c	1.0E-01
Aroclor 1254	11097-69-1	2.2E-01	c	1.0E+01	c	3.4E-02	c	1.8E-01
Aroclor 1260	11096-82-5	2.2E-01	c	1.0E+01	c	3.4E-02	c	4.7E-01
Polycyclic Aromatic Hydrocarbons (PAHs)								
Acenaphthene	83-32-9	4.1E+03	nc	6.6E+04	nc	3.0E+02	nc	6.1E+01
Acenaphthylene	208-96-8	4.3E+03	nc	7.4E+04	nc	3.0E+02	nc	6.1E+01

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Anthracene	120-12-7	2.3E+04	nc	6.1E+05	nc	4.7E+03	nc	3.1E+03
Benz[a]anthracene	56-55-3	1.5E-01	c	2.9E+01	c	2.9E-02	c	2.1E-01
Benzo[b]fluoranthene	205-99-2	1.5E-01	c	2.9E+01	c	2.9E-02	c	7.1E-01
Benzo[k]fluoranthene	207-08-9	1.5E+00	c	2.9E+02	c	2.9E-01	c	6.9E+00
Benzo[g,h,i]perylene	191-24-2	1.7E+03	nc	2.3E+04	nc	4.7E+02	nc	3.7E+04
Benzo[a]pyrene	50-32-8	1.5E-02	c	2.9E+00	c	2.0E-01	gws	4.7E+00
Chrysene	218-01-9	1.5E+01	c	2.9E+03	c	2.9E+00	c	2.1E+01
Dibenz[ah]anthracene	53-70-3	1.5E-02	c	2.9E+00	c	2.9E-03	c	2.3E-01
Fluoranthene	206-44-0	2.3E+03	nc	3.0E+04	nc	6.3E+02	nc	1.4E+03
Fluorene	86-73-7	2.9E+03	nc	5.7E+04	nc	2.0E+02	nc	7.4E+01
Indeno[1,2,3-cd]pyrene	193-39-5	1.5E-01	c	2.9E+01	c	2.9E-02	c	2.3E+00
1-Methylnaphthalene	90-12-0	2.2E+01	c	3.5E+02	Csat	2.3E+00	c	1.1E-02
2-Methylnaphthalene	91-57-6	3.1E+02	nc	8.2E+03	nc	6.3E+01	nc	5.1E-01
Naphthalene	91-20-3	3.6E+00	c	1.8E+02	c	1.4E-01	c	9.4E-03
Phenanthrene	85-01-8	2.3E+04	nc	6.1E+05	nc	4.7E+03	nc	3.2E+03
Pyrene	129-00-0	2.3E+03	nc	5.8E+04	nc	1.5E+02	nc	3.2E+02
Prometon	1610-18-0	9.2E+02	nc	1.3E+04	nc	2.3E+02	nc	2.2E+00
Prometryn	7287-19-6	2.4E+02	nc	3.5E+03	nc	6.3E+01	nc	1.9E+00
Propachlor	1918-16-7	7.9E+02	nc	1.1E+04	nc	2.0E+02	nc	2.5E+00
Propanil	709-98-8	3.1E+02	nc	4.4E+03	nc	7.8E+01	nc	8.6E-01
Propargite	2312-35-8	1.2E+03	nc	1.8E+04	nc	3.1E+02	nc	4.6E+02
n-Propylbenzene	103-65-1	2.6E+02	Csat	2.6E+02	Csat	8.9E+02	nc	3.3E+01
Propylene glycol	57-55-6	1.0E+06	max	1.0E+06	max	3.1E+05	nc	1.3E+03
Propylene glycol, monoethyl ether	1569-02-4	4.3E+04	nc	6.2E+05	nc	1.1E+04	nc	4.4E+01
Propylene glycol, monomethyl ether	107-98-2	4.3E+04	nc	6.2E+05	nc	1.1E+04	nc	4.4E+01
Pursuit	81335-77-5	1.5E+04	nc	2.2E+05	nc	3.9E+03	nc	6.9E+01
Pyridine	110-86-1	5.8E+01	nc	6.4E+02	nc	5.0E+00	nc	3.4E-02

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Quinoline	91-22-5	1.6E-01	c	8.2E+00	c	2.2E-02	c	1.5E-03
RDX (Cyclonite)	121-82-4	5.5E+00	c	4.3E+02	c	6.1E-01	c	4.6E-03
Resmethrin	10453-86-8	1.8E+03	nc	2.6E+04	nc	4.7E+02	nc	5.8E+03
Ronnel	299-84-3	3.1E+03	nc	4.4E+04	nc	7.8E+02	nc	1.4E+02
Rotenone	83-79-4	2.4E+02	nc	3.5E+03	nc	6.3E+01	nc	6.5E+02
Selenious Acid	7783-00-8	3.9E+02	nc	1.0E+04	nc	7.8E+01	nc	
Selenium	7782-49-2	3.9E+02	nc	1.0E+04	nc	5.0E+01	gws	5.2E+00
Silver and compounds	7440-22-4	3.9E+02	nc	1.0E+04	nc	7.8E+01	nc	1.3E+01
Simazine	122-34-9	4.0E+00	c	2.1E+02	c	4.0E+00	gws	4.0E-02
Sodium azide	26628-22-8	3.1E+02	nc	8.2E+03	nc	6.3E+01	nc	
Sodium diethyldithiocarbamate	148-18-5	1.8E+00	c	9.1E+01	c	2.5E-01	c	3.0E-03
Strontium, stable	7440-24-6	4.7E+04	nc	1.0E+06	max	9.4E+03	nc	6.6E+03
Strychnine	57-24-9	1.8E+01	nc	2.6E+02	nc	4.7E+00	nc	1.0E+00
Styrene	100-42-5	8.7E+02	Csat	8.7E+02	Csat	1.0E+02	gws	2.2E+00
tert-butanol	75-65-0	1.4E+03	nc	3.7E+04	nc	2.8E+02	nc	5.9E-02
2,3,7,8-Tetrachlorodibenzodioxin (TCDD/dioxin)	1746-01-6	4.5E-06	c	3.2E-04	c	3.0E-05	gws	3.0E-04
1,2,4,5-Tetrachlorobenzene	95-94-3	1.8E+01	nc	2.6E+02	nc	4.7E+00	nc	4.4E-01
1,1,1,2-Tetrachloroethane	630-20-6	1.9E+00	c	9.8E+01	c	5.2E-01	c	4.0E-03
1,1,2,2-Tetrachloroethane	79-34-5	5.7E-01	c	3.1E+01	c	6.7E-02	c	5.3E-04
Tetrachloroethylene (PCE)	127-18-4	2.2E+01	c	1.7E+02	Csat	5.0E+00	gws	4.5E-02
2,3,4,6-Tetrachlorophenol	58-90-2	1.8E+03	nc	2.6E+04	nc	4.7E+02	nc	5.8E+01
p,a,a,a-Tetrachlorotoluene	5216-25-1	2.4E-02	c	1.2E+00	c	3.4E-03	c	2.3E-04
Tetrahydrofuran	109-99-9	2.0E+04	nc	1.1E+05	nc	3.2E+03	nc	1.4E+01
Thallium and compounds	7440-28-0	7.8E-01	nc	2.0E+01	nc	2.0E+00	gws	2.8E+00
Thiobencarb	28249-77-6	6.1E+02	nc	8.8E+03	nc	1.6E+02	nc	1.1E+01
Thiocyanate	463-56-9	1.6E+01	nc	4.1E+02	nc	3.1E+00	nc	1.3E-02
Tin and compounds	7440-31-5	4.7E+04	nc	1.0E+06	max	9.4E+03	nc	4.7E+04

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
Toluene	108-88-3	8.2E+02	Csat	8.2E+02	Csat	1.0E+03	gws	1.4E+01
Toluene-2,4-diamine	95-80-7	1.5E-01	c	7.7E+00	c	2.1E-02	c	1.3E-04
Toluene-2,5-diamine	95-70-5	2.7E+00	c	1.4E+02	c	3.7E-01	c	2.3E-03
Toluene-2,6-diamine	823-40-5	1.8E+03	nc	2.6E+04	nc	4.7E+02	nc	2.9E+00
p-Toluidine	106-49-0	2.6E+00	c	1.3E+02	c	3.5E-01	c	3.0E-03
Toxaphene	8001-35-2	4.4E-01	c	2.2E+01	c	3.0E+00	gws	9.3E+00
1,2,4-Tribromobenzene	615-54-3	3.1E+02	nc	4.4E+03	nc	7.8E+01	nc	2.2E+00
Tributyltin oxide (TBTO)	56-35-9	1.8E+01	nc	2.6E+02	nc	4.7E+00	nc	4.9E+03
2,4,6-Trichloroaniline	634-93-5	1.4E+01	c	7.3E+02	c	2.0E+00	c	3.6E-01
1,2,4-Trichlorobenzene	120-82-1	2.2E+01	c	2.8E+02	nc	7.0E+01	gws	4.1E+00
1,1,1-Trichloroethane	71-55-6	6.4E+02	Csat	6.4E+02	Csat	2.0E+02	gws	1.4E+00
1,1,2-Trichloroethane	79-00-5	1.1E+00	c	5.7E+01	c	5.0E+00	gws	3.2E-02
Trichloroethylene (TCE)	79-01-6	4.8E-01	c	2.1E+01	nc	5.0E+00	gws	3.6E-02
Trichlorofluoromethane	75-69-4	7.9E+02	nc	1.2E+03	Csat	1.1E+03	nc	1.4E+01
2,4,5-Trichlorophenol	95-95-4	6.1E+03	nc	8.8E+04	nc	1.6E+03	nc	1.2E+02
2,4,6-Trichlorophenol	88-06-2	4.4E+01	c	8.8E+02	nc	6.1E+00	c	4.6E-01
2,4,5-Trichlorophenoxyacetic Acid	93-76-5	6.1E+02	nc	8.8E+03	nc	1.6E+02	nc	1.3E+00
2-(2,4,5-Trichlorophenoxy) propionic acid	93-72-1	4.9E+02	nc	7.0E+03	nc	5.0E+01	gws	5.5E-01
1,1,2-Trichloropropane	598-77-6	1.7E+02	nc	1.1E+03	nc	2.5E+01	nc	1.9E-01
1,2,3-Trichloropropane	96-18-4	5.0E-03	c	1.9E+00	c	7.2E-04	c	6.2E-06
1,2,3-Trichloropropene	96-19-5	7.9E-01	nc	3.3E+00	nc	6.2E-01	nc	6.1E-03
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	9.1E+02	Csat	9.1E+02	Csat	5.5E+04	nc	2.8E+03
1,2,4-Trimethylbenzene	95-63-6	6.3E+01	nc	2.2E+02	Csat	1.5E+01	nc	4.2E-01
1,3,5-Trimethylbenzene	108-67-8	1.8E+02	Csat	1.8E+02	Csat	1.6E+02	nc	4.5E+00
Trimethyl phosphate	512-56-1	2.4E+01	c	1.2E+03	c	3.4E+00	c	1.5E-02
1,3,5-Trinitrobenzene	99-35-4	2.2E+03	nc	4.9E+04	nc	4.7E+02	nc	3.3E+01
Trinitrophenylmethylnitramine (Tetryl)	479-45-8	2.4E+02	nc	3.5E+03	nc	6.3E+01	nc	1.2E+01

CONTAMINANT	CAS No	Residential Soil ^{1,4} (mg/kg)	Value Basis ⁵	Industrial Soil ^{1,4} (mg/kg)	Value Basis ⁵	Groundwater ^{2,4} (µg/l)	Value Basis ⁵	Migration to Groundwater ^{3,4} (mg/kg)
2,4,6-Trinitrotoluene	118-96-7	1.9E+01	c	7.2E+02	nc	2.2E+00	c	2.6E-01
Vanadium and compounds	7440-62-2	5.5E+00	nc	1.4E+02	nc	1.1E+00	nc	2.2E+01
Vinclozolin	50471-44-8	1.5E+03	nc	2.2E+04	nc	3.9E+02	nc	6.0E+00
Vinyl acetate	108-05-4	9.8E+02	nc	2.7E+03	Csat	4.1E+02	nc	1.7E+00
Vinyl bromide	593-60-2	1.1E-01	c	5.7E+00	c	1.5E-01	c	8.8E-04
Vinyl chloride (lifetime)	75-01-4	5.5E-02	c			2.0E+00	gws	1.4E-02
Vinyl chloride (adult)	75-01-4			2.1E+01	c	2.0E+00	gws	1.4E-02
Warfarin	81-81-2	1.8E+01	nc	2.6E+02	nc	4.7E+00	nc	9.9E-02
Xylenes	1330-20-7	2.6E+02	Csat	2.6E+02	Csat	1.0E+04	gws	2.0E+02
Zinc	7440-66-6	2.3E+04	nc	6.1E+05	nc	4.7E+03	nc	5.8E+03
Zinc phosphide	1314-84-7	2.3E+01	nc	6.1E+02	nc	4.7E+00	nc	
Zineb	12122-67-7	3.1E+03	nc	4.4E+04	nc	7.8E+02	nc	4.5E+01

Notes:

- 1 Where appropriate, the residential and industrial soil values consider ingestion and dermal exposure to soil and inhalation exposure to contaminants moving from soil to ambient air.
 - 2 Groundwater standards promulgated under 47CSR12 are provided, where available. Standards that are unavailable under 47CSR12 are based on a risk-based methodology that considers ingestion and inhalation exposure arising from the domestic use of groundwater.
 - 3 The migration from soil to groundwater values shall be applied, unless it is shown to the satisfaction of the Secretary that migration of soil contaminants to groundwater will not result in an exceedance of the De Minimis Groundwater Standards.
 - 4 The concentrations in this table shall be applied where the exposure pathways described in footnotes 1, 2, and 3 are the major contributors to risks identified in the site assessment. If other exposure pathways are identified, the acceptable contractions shall be determined only in consultation with the Secretary, considering all exposure pathways, and all other requirements of the regulations.
 - 5 Basis of standard: c – cancer effect; nc – noncancer effect; max – calculated risk-based concentration exceeds possible contaminant level of 1×10^6 mg/kg; Csat – calculated risk-based concentration exceeds residual saturation level; gws – West Virginia Groundwater Quality Standards from 47CSR12.
- * Lead – Residential soil based on Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (July 1994), USEPA OSWER Directive 9355.4-12. Industrial soil based on the USEPA documents Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soils (December 1996) and Frequently Asked Questions (FAQs) on the Adult Lead Model (April 1999).

APPENDIX B: STANDARD OPERATING PROCEDURES (SOPS)

General Decontamination Procedures for Non-Disposable Field Sampling Equipment

SOP OER-0100

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	7/1/2010	Reformatted, added SOP ID #, and renumbered. Supersedes Revision 0.0 Additional detail provided for decontamination procedures.	Editorial Technical
Dave Long	2.0	9/21/2016	Revised decontamination procedures. Reformatted.	Editorial, Technical

**GENERAL DECONTAMINATION PROCEDURES FOR NON-
DISPOSABLE FIELD SAMPLING EQUIPMENT**
SOP OER-0100

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1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide a description of the methods used for non-disposable field equipment decontamination. Field equipment decontamination serves many purposes, including, but not necessarily limited to:

- Preventing, minimizing, or limiting cross-contamination of samples
- Preventing cross-contamination of sampling locations
- Ensuring collection of representative samples
- Ensuring proper operation of field equipment
- Ensuring accuracy of field measurements
- Reducing potential exposure hazards for field personnel
- Preventing contamination of uncontaminated areas

This SOP also provides general guidelines for developing decontamination procedures for sampling equipment to be used for OER projects. This SOP does not address personnel decontamination.

These are standard (i.e. typically applicable) operating procedures which may be varied or changed as needed, dependent upon site conditions, equipment limitation, and/or limitations imposed by the procedure. The actual procedures employed at a site should be fully documented.

2.0 SUMMARY OF METHOD

All non-disposable sampling equipment (including, but not limited to: augers, GeoProbe™ drive rods, trowels, spatulas, hand augers, shovels, stainless steel mixing bowls, split spoon sampler, GeoProbe™ sampling spoon, etc.) will be thoroughly cleaned. Decontamination of all sampling equipment will be accomplished prior to and between sampling locations. The decontamination procedure is briefly summarized below.

Sampling equipment to be used at the site will be divided into one of two categories:

1. Equipment that does not contact the sample
2. Equipment that does contact the sample

Procedures for Non-Sample Contacting Equipment

- a) Physically removal gross contamination.
- b) Clean with portable power washer steam cleaning machine or dedicated pressurized sprayer *or* hand wash with brush using detergent solution.
- c) Rinse with control water.

Procedures for Sample Contacting Equipment

- a) Physically remove gross contamination.
- b) Wash with non-phosphate detergent and brush made of inert material.
[Note: For equipment that cannot be disassembled for cleaning (e.g., tubing), circulate decontamination liquid through the equipment.]
- c) Rinse with distilled water.
- d) Rinse with inorganic desorbing agent (applicable only when analyzing for inorganics).
- e) Rinse with distilled water.
- f) Rinse with organic desorbing agent rinse (applicable only when analyzing for organics).
- g) Rinse with deionized water.
- h) Let equipment air dry.
- i) Wrap equipment in inert material (e.g., aluminum foil or plastic wrap) for transport, to prevent contact with potentially contaminated materials.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Sample collection and analysis of decontamination waste may be required before beginning proper disposal of decontamination liquids and solids generated at a site. The amount of sample to be collected and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements should be determined prior to initiation of site activities. As part of the development of the project specific Sampling and Analysis Plan (SAP), decontamination waste sampling procedures should be determined and then incorporated into the SAP. Parameters to be sampled will be dependent upon the matrix being sampled and the requirements of the disposal facility.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The use of an untreated potable water supply is not an acceptable substitute for tap water. The use of distilled/deionized water commonly available from commercial vendors should generally be acceptable for decontamination of sampling equipment. If there is a concern that the water is not analyte free, then it can be verified by laboratory analysis. If acids or solvents are utilized in decontamination they raise health and safety as well as waste disposal concerns. Care must be used when working with acids and organic solvents.

5.0 EQUIPMENT APPARATUS

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations include the ease of decontaminating or disposing of the equipment. The

following are some of the materials and equipment that are potentially needed for decontamination activities:

- Non-phosphate detergent
- Organic and inorganic decontamination reagents, if required by site-specific SAP
- Tap water
- Distilled or deionized water
- Brushes (various assortment of sizes)
- Drop cloth/plastic sheeting
- Paper towels
- Wash and rinse containers (buckets)
- Portable power washer, steam cleaning machine or pressurized sprayers
- Solvent sprayers
- Aluminum foil/plastic wrap
- Trowel
- Trash bags
- Trash containers
- DOT approved 55-gallon drums
- Safety glasses
- Gloves
- Eyewash
- First aid kit

6.0 REAGENTS

Depending upon the project, a solvent rinse using organic or inorganic desorbing agent may be required. This shall be specified in the site-specific SAP. In cases where the use of solvents is planned, the analytical laboratory performing the analysis shall be consulted prior to sampling to ensure that decontamination procedures do not affect the subsequent analysis. It is recommended that all solvent rinses be made from an appropriate grade of chemical, such as pesticide or purge-and-trap grade quality.

7.0 PROCEDURES

These procedures are intended as general procedures to be followed for decontamination of field sampling equipment. The site-specific SAP should be referred to for any given project in order

to establish what portions of these procedures are applicable to the project. It is always recommended that procedures be established in the site-specific SAP to minimize the potential for contamination. Such procedures may include the following:

- Work practices that minimize contact with potential contaminants
- Covering monitoring and sampling equipment with plastic or other protective material
- Avoiding laying equipment down in areas of obvious contamination
- Use of disposable sampling equipment

7.1 Decontamination Methods

Various decontamination methods will physically remove contaminants, inactivate contaminants by disinfection or sterilization, or do both. In many cases, gross contamination can be removed by physical means. The physical decontamination techniques appropriate for equipment decontamination can be grouped into two categories: abrasive methods and non-abrasive methods.

7.1.1 Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The following abrasive methods are available:

- Mechanical cleaning methods are brushes of metal or nylon. The amount and type of contaminants removed will vary with the hardness of bristles, length of brushing time, and degree of brush contact.
- Air blasting is used for cleaning large equipment, such as bulldozers, drilling rigs or auger bits. The equipment used in air blast cleaning employs compressed air to force abrasive material through a nozzle at high velocities. The distance between the nozzle and the surface cleaned, as well as the pressure of air, the time of application, and the angle at which the abrasive strikes the surface, determines cleaning efficiency. This method generates a large amount of waste and is unlikely to be utilized on OER projects.
- Wet blast cleaning, also used to clean large equipment, involves use of a suspended fine abrasive delivered by compressed air to the contaminated area. The amount of materials removed can be carefully controlled by using very fine abrasives. This method generates a large amount of waste and is unlikely to be utilized on OER projects.

7.1.2 Non-Abrasive Cleaning Methods

Non-abrasive cleaning methods work by forcing the contaminant off of a surface with pressure. The following non-abrasive methods are available:

<u>High-Pressure Water:</u>	This method consists of a high-pressure pump, an operator controlled directional nozzle, and a high pressure hose.
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Low-Pressure Water: This system produces a pressurized water jet with operating pressures less than 240 atm which relates to a flow rate less than 20 liters per minute. Because of the low pressure, this method is applicable for hand-held sampling equipment.

7.1.3 Disinfection/Rinse/Hand Removal Methods

Disinfection/Sterilization: Disinfectants are a practical means of inactivating infectious agents; sterilization methods involve heating the equipment which is impractical for large equipment. It is unlikely that these methods would be utilized on OER projects.

Rinsing: In cases of gross soil/sediment contamination on hand held sampling equipment, a tap water rinse/wash may first be performed to remove clumps of dirt in order to make the detergent wash more effective.

Hand Removal: In cases of gross soil/sediment contamination on hand held sampling equipment, dirt may be removed by hand (gloved) or using a trowel or similar device to remove clumps of dirt in order to make the detergent wash more effective.

7.2 Field Sampling Equipment Cleaning Procedures

If trace analysis for organics or metals is to be performed, then a solvent rinse for trace organics and an acid rinse for trace metals would be appropriate. If no trace analysis is planned, the solvent and acid rinses may be eliminated from the decontamination sequence specified below.

- a) In cases of gross contamination, follow the most appropriate physical removal procedures specified in section 7.1.
- b) Using a brush, wash equipment with soap (non-phosphate) and water.
- c) Rinse the equipment with tap water. If contaminants are clearly present, wash the equipment again and rinse again with tap water.
- d) Rinse with distilled/deionized water. A triple rinse with distilled/deionized water is recommended. (If solvent or acid rinses are not necessary, then proceed to step 9.)
- e) If applicable, rinse with an inorganic desorbing agent if the samples will be analyzed for inorganics.
- f) Rinse with distilled/deionized water.
- g) Use an organic desorbing agent rinse, as appropriate, if the sample will be analyzed for organics.
- h) Rinse with distilled/deionized water.

- i) Decontaminated equipment shall be dried or allowed to air dry on plastic sheeting in an area free of potential contaminants.
- j) Wrap equipment in inert material (e.g., aluminum foil or plastic wrap) for transport. Store decontaminated equipment in an area free of potential contaminants when it is not in use.

8.0 CALCULATIONS

There are no calculations associated with decontamination procedures. This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Decontamination of field sampling equipment is necessary when dedicated or non-disposable sampling equipment is utilized at a site. An equipment rinsate blank should be collected as part of the quality control associated with the field decontamination on non-disposable, dedicated sampling equipment. This sample will provide information on the effectiveness of the decontamination process in the field. Equipment rinsate blanks are samples obtained by running distilled or deionized water over the decontaminated sampling equipment after cleaning to test for residual contamination. The equipment rinsate water is collected in sample containers and handled exactly as any other samples from the site. One equipment rinsate blank should be collected per each day of field work. An equipment rinsate blank is used to assess cross-contamination brought about by improper decontamination procedures.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered to when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training with 8 Hour refreshers as appropriate. Some level of personal protective equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the site health and safety plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derived waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Sampling Equipment Decontamination, SOP# 2006, US EPA, Environmental Response Team, August 11, 1994

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005, Update – April, 2011

ASTM D5088-15a, *Standard Practice for Decontamination of Field Equipment Used at Waste Sites*, ASTM International, West Conshohocken, PA, 2015, www.astm.org

US EPA, 2015, *Field Equipment Cleaning and Decontamination*; SESD PROC-205-R3, U.S. Environmental Protection Agency Region 4, Athens, GA, 18 pp.

PID Field Screening

SOP OER-0101

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	8/2/2010	New SOP	Technical
Dave Long	1.0	9/21/2016	Revised PID Screening Procedures. Reformatted.	Editorial, Technical

PID FIELD SCREENING

SOP OER-0101

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1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe the procedure for using a photoionization detector (PID). The PID is a portable vapor/gas detector employing the principle of photoionization to detect a variety of chemical compounds. It is of particular use in identifying organic compounds, but can identify certain inorganic compounds such as chlorine, bromine, silicon, and sulfur. This procedure is a non-specific method applicable to field screening for organic compounds in surface and subsurface soils.

2.0 SUMMARY OF METHOD

The PID is a useful field screening tool. A PID is capable of detecting and measuring real-time concentrations of many organic vapors and some inorganic vapors. The PID is unable to respond to certain low molecular weight hydrocarbons, such as methane and ethane. The PID works by employing the principle of photoionization. It will respond to most vapors that have an ionization potential less than or equal to that supplied by the ionization source. The ionization source is an ultraviolet (UV) lamp.

Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and form a positive ion. This will occur when the ionization potential of the molecule in electron volts (eV) is less than the energy of the photon. Several ionization sources are available for the PID, each having a different eV lamp and a different ionization potential. The selection of the appropriate ionization source is essential in obtaining useful data. Though it can be calibrated to a particular compound, the instrument cannot distinguish between detectable compounds in a mixture of gases. Therefore, the PID can only indicate an integrated response to the mixture; the primary use of the PID is as a quantitative instrument.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The PID is a nonspecific total vapor detector; therefore, it cannot be used to identify unknown substances. The PID does not respond to certain low molecular weight hydrocarbons, such as methane and ethane. The PID does not detect a compound if the probe has a lower energy than the compound's ionization potential. Certain toxic gases and vapors, such as carbon tetrachloride and hydrogen cyanide, have high ionization potentials and cannot be detected with a PID. Strong winds and high humidity will affect measurement readings. A PID may become unusable under foggy or humid conditions. The lamp window must be periodically cleaned to ensure ionization of the compounds by the probe. Pulling liquids into the probe will result in poor readings and can damage the instrument.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil screening activities using the PID. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- PID
- Calibration equipment and gases (isobutylene)
- Mason Jars
- Aluminum Foil
- Field logbook, field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Pails, tubs, or buckets
- Plastic sheeting
- Packing materials
- Sampling gloves
- Methanol
- Light source cleaning compound
- Mild, non-phosphate soap

6.0 REAGENTS

The following reagents may be needed when using a PID for field screening purposes:

- Isobutylene standards for calibration
- Methanol for cleaning ionization chamber (GC grade)
- Mild soap solution for cleaning unit surfaces
- Specific gas standards when calibrating to a specific compound (as applicable)
- Light source cleaning compound

7.0 PROCEDURES

The following procedures are applicable for static field screening of organic compounds utilizing a PID:

- a) Conduct a fresh air calibration and multi-sensor span calibration on the instrument daily in accordance with manufacturer specifications before any headspace readings are performed. Re-calibrate the instrument throughout the day as needed.
- b) Place the portion of soil sample to be screened inside a clean mason jar or other air-tight cylinder and then seal the jar using aluminum foil and the screw-on lid. Fill the jar at least 1/3 the way full (no more than 1/2 full) if sufficient sample is available.
- c) Allow the jar to set for no more than ten minutes prior to taking a reading. *Note: If the ambient temperature is below 60 degrees Fahrenheit, headspace analysis shall be conducted in a heated environment (i.e., inside a building or vehicle).*
- d) Pierce the aluminum foil with the probe tip of the PID; the jar shall not be reopened for the insertion of the probe tip. *Note: Care shall be taken to ensure that neither water droplets nor soil particulates enter the probe tip.*
- e) The highest meter response shall be recorded as the volatile organic vapor concentration.
- f) All headspace analysis shall be completed at an equivalent time period between 8-10 minutes for specific samples.
- g) Record the PID readings in the field logbook along with other sampling information such as:
 - Method of screening (static)
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Any other pertinent information

The following procedures are applicable for dynamic field screening of organic compound utilizing a PID:

- a) Calibrate the instrument daily in accordance with manufacturer specifications before any headspace readings are performed. Re-calibrate the instrument throughout the day as needed.

- b) Place the portion of soil sample to be screened inside a clean mason jar or other air-tight cylinder and then seal the jar using aluminum foil and the screw-on lid. Fill the jar at least 1/3 the way full (no more than 1/2 full) if sufficient sample is available.
- c) Shake the soil in the jar in order to induce volatilization of compounds into the headspace; alternately, the jar may be heated to induce volatilization.
- d) Allow the jar to set for no more than ten minutes prior to taking a reading.
- e) Pierce the aluminum foil with the probe tip of the PID - the jar shall not be reopened for the insertion of the probe tip. *Note: Care shall be taken to ensure that neither water droplets nor soil particulates enter the probe tip.*
- f) The highest meter response shall be recorded as the volatile organic vapor concentration.
- g) All headspace analysis shall be completed at an equivalent time period between 10 to 15 minutes for specific samples.
- h) Record the PID readings in the field logbook along with other sampling information such as:
 - Method of screening (static)
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Any other pertinent information

Note: Soil samples collected for field soil screening may not be used for laboratory analysis. Separate soil samples must be collected according to the soil sampling protocols outlined in the site-specific Sampling and Analysis Plan.

8.0 CALCULATIONS

No calculations are applicable to this SOP. The PID is a direct reading instrument.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities which apply to these procedures. However, the following general QA procedures do apply:

- All data must be documented on field data sheets and/or in field logbooks.

- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
- Equipment calibration activities must be documented and must occur prior to beginning sampling operations. Performance checks on the PID should be performed throughout the course of a day, and recalibration of the instrument should be performed as needed.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

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XRF Field Screening

SOP OER-0102

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	8/3/2010	New SOP	Technical

XRF FIELD SCREENING

SOP OER-0102

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1.0 SCOPE AND APPLICATION

This procedure is applicable to field screening of a variety of metals in surface and subsurface soils. This is a field screening method used for profiling an area, locating sources of contamination, determining the horizontal and vertical extent of contamination, and/or collecting preliminary data that may be used to design a sampling plan.

X-Ray Fluorescence Spectroscopy (XRF) is a nondestructive qualitative and quantitative analytical technique used to determine the chemical composition of samples. Primary X-rays are emitted from a sealed radioisotope source and are utilized to irradiate samples. In the samples, radiation knocks out an electron from the innermost shell of an atom. The atom is excited and releases its surplus energy almost instantly by filling the vacancy created with an electron from one of the higher energy shells. This rearrangement of electrons is associated with emission of X-rays characteristic of the given atom and represents an emission of fluorescent X-rays. Energies of the characteristic, fluorescent X-rays are converted within the detector into electric pulses, the amplitudes of which are linearly proportional to the energy. An electronic analyzer measures the pulse amplitudes which are the basis of a qualitative X-ray analysis. The number of equivalent counts at a given energy is representative of element concentration in a sample basis for quantitative analysis.

2.0 SUMMARY OF METHOD

Testing of samples may be done in-situ, in plastic bags with minimal preparation, or in plastic bags or the XRF cup with more extensive sample preparation. If the primary objective of the sampling event is to determine whether an element is present, then in-situ or bagged samples with little preparation would be the quickest simplest way to proceed. If measuring accuracy of the concentration of metal present is the primary objective, then additional preparation of the sample is recommended. Precision and accuracy between samples is best achieved with prepared homogenous samples.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Generally, the instrument precision is the least significant source of error in XRF analysis. User or application related error is most often the most significant source of error. Following are some of the components of user or application related errors.

4.1 Sample Placement

This is a potential source of error since the X-ray signal decreases as you increase the distance from the radioactive source. This type of error can be minimized by maintaining the same sample distance from the source. This SOP allows for the use of a thin plastic wrap (like Saran Wrap) that can be placed between the soil and the analyzer window to keep the window clean. This has little, if any, effect on the distance from the sample to the radioactive source; therefore,

it does not cause a potential source of error due sample placement issues. However, for a few elements (namely Chromium, Vanadium, and Barium) testing through thin plastic may result in lower readings (~ 20%) for these elements.

4.2 Representative Nature of Samples

Heterogeneous samples can be a major source of error. This error can be minimized by either homogenizing a large volume of sample prior to analyzing an aliquot, or by analyzing several samples (in-situ) at each sampling point and then averaging the results.

4.3 Chemical Matrix Effects

Chemical matrix effects result from differences in concentrations of interfering elements. These effects appear as either spectral interferences (peak overlaps) or as X-ray absorption/enhancement phenomena. Both effects are common in soils contaminated with heavy metals. For example, Fe (iron) tends to absorb Cu (copper), reducing the intensity of Cu measured by the detector.

4.4 Physical Matrix Effects

Physical matrix effects are the result of variations in the physical character of the sample. They may include such parameters as particle size, uniformity, homogeneity and surface condition.

4.5 Moisture Content

The overall error from moisture may be a minor source of error when the moisture range is small (5-20%), or may be a major source of error when measuring on the surface of soils that are saturated with water.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil screening activities using the XRF. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- XRF
- Batteries and chargers
- Standardization clip
- Sieves
- Plastic bags
- Mortar and pestle
- Sample test stand, if desired
- Logbook
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable

- Pails, tubs, or buckets
- Plastic sheeting
- Packing materials
- Sampling gloves

6.0 REAGENTS

Standardization of the XRF is performed utilizing the metal standardization clip; therefore, reagents are not generally used for site screening using the XRF. Reagents associated with decontamination of sampling equipment may be applicable if samples are not analyzed “in-situ”. Refer to SOP OER-0100 for general decontamination procedures for non-disposable sampling equipment.

7.0 PROCEDURES

7.1 General Procedures

- Install a fully charged battery in the instrument and verify that the iPAQ is correctly seated on the top of the unit. If the iPAQ is properly connected, the amber light on the upper right side of the iPAQ will blink.
- Turn both the XRF (back of the unit) and the iPAQ (top right hand side) on. If the iPAQ fails to turn on, it may be necessary to perform a “soft reset”. *(Note: Remove the iPAQ from the unit, insert the tip of the stylus into the small hole on the bottom left hand side of the iPAQ to perform a “soft reset.” Re-seat the iPAQ back into the instrument.)*
- Start the Innov-X Systems software by selecting the Start Menu from the upper right hand corner of the iPAQ screen. Select the Innov-X software from the drop down menu. *(Note: The red light on the end of the instrument will be on when it is on and ready for use. It will flash when the trigger is pulled indicating that the instrument is emitting radiation.)*
- Select Start and the Main Menu will open.
- Choose the test mode (Soil) from the menu. *(Note: It will take a minute or two for the instrument to go through a hardware initiation phase.)*
- The instrument will prompt you to perform a standardization test. The instrument will not operate until a successful standardization test has been performed. Place the standardization clip securely over the sample window of the XRF and tap the message box to initiate standardization which will take about 1 minute.
- When standardization is complete, the resolution of the analyzer will be displayed. Tap OK to acknowledge and clear the screen.
- If you wish to enter a sample name or sample id, select EDIT→ Test Info. Enter information in text fields, or select items from drop down menus. In the soil mode there are preset options such as Operator, Sample Method, Sample Number, Sample

Depth and comments. These can be customized as necessary. Fill in the information for the sample prior to analysis. The analysis will be stored with this information. You will need to enter new sample information prior to each sample run. Select OK to close the test information window.

- i) The analyzer is now ready to take measurements.

7.2 In-Site Analysis

These procedures are applicable for analysis of surface soils and can be used for vertical profiling of acetate sleeves retrieved by direct push technology.

- a) Complete the procedures outlined in the General Procedures Section.
- b) Clear the area selected for analysis of any surface debris or vegetation. Level the area so the XRF sample window will contact the area evenly. If desired, a thin plastic wrap (like Saran Wrap) can be placed between the soil and the analyzer window to keep the window clean. *(Note: Except for a few elements (namely Chromium, Vanadium, and Barium) testing through the thin plastic has little effect on the test results. Results for chromium, vanadium, and barium may be lower by 20 to 30%.)*
- c) Hold the XRF to the sample. Make sure the sample is as flush against the analyzing window as is possible. To start the test, pull and hold the trigger. Releasing the trigger prematurely will abort the analysis. *(Note: The software lock may have to be disabled if the instrument has not been used for more than 5 minutes.)* After analysis is started, the message, “TEST IN PROGRESS” will appear with a timer. For the duration of the test, the red light on the XRF will blink and the “testing” icon will appear in the lower right hand corner of the iPAQ. The results will be displayed on the screen after a short time.
- d) Once the result screen opens, you can enter new sample information for the next sample as outlined in the General Procedures and then press the trigger to analyze the next sample. To exit the analysis screen, select FILE→ EXIT or tap the X in the upper right hand corner of the screen.

7.3 Bagged Soil Sample Testing

- a) A soil sample is collected in a thin plastic bag (i.e. a “baggie”). It is recommended that at least 100 grams of soil are placed in the baggie. When shooting the soil, a thickness of at least 0.5 inches of soil in the bag is recommended.
- b) When placing soil in the baggie, remove vegetation, debris, and rocks from the soil to the extent practical. Mix the soil in the baggie to homogenize it. If greater accuracy is desired, dry soil may be passed through a 10 um sieve to better homogenize it. A mortar and pestle may be used to break the soil into smaller particles to ease its passage through the sieve. If wet soil is encountered, using a sieve is not an option in the field unless a method to dry the soil can be found.

- c) Hold the XRF to the sample. Make sure the sample is as flush against the analyzing window as is possible. To start the test, pull and hold the trigger. Releasing the trigger prematurely will abort the analysis. *(Note: The software lock may have to be disabled if the instrument has not been used for more than 5 minutes.)* After analysis is started, the message, "TEST IN PROGRESS" will appear with a timer. For the duration of the test, the red light on the XRF will blink and the "testing" icon will appear in the lower right hand corner of the iPAQ. The results will be displayed on the screen after a short time.
- d) Once the result screen opens, you can enter new sample information for the next sample as outlined in the General Procedures and then press the trigger to analyze the next sample. To exit the analysis screen, select FILE→ EXIT or tap the X in the upper right hand corner of the screen.

8.0 CALCULATIONS

No calculations are applicable to this SOP. The XRF is a direct reading instrument.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The analysis of soils by XRF should be considered as a screening tool. Data derived from the instrument should be used with discretion. The following general QA procedures apply:

- All data must be documented on field data sheets, in field logbooks, and/or downloaded to a computer.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
- Equipment calibration activities must be documented and must occur prior to beginning sampling operations. Performance checks on the XRF should be performed throughout the course of a day, and re-standardization of the instrument should be performed as needed.
- Confirmation samples should be collected at a minimum rate of 10% and sent to a laboratory for analysis. In order to properly perform a comparative analysis of the field screening method with the lab data, it is important to send the soil to the lab that was actually field screened due to the potential problems noted in Section 4.0 of this SOP.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

Confirmation samples are recommended at a minimum rate of 10%. Ideally, the sample that was analyzed by XRF should be the same sample that is sent for laboratory analysis. When confirming an in-situ analysis, collect a sample from a six-inch by six-inch area for both an XRF measurement and confirmation analysis.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered to when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with soil sampling and the use of the XRF for environmental analysis:

- Exposure to unknown contaminants.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slip, trip, and fall.
- The XRF has a radiation source. The XRF should not be pointed at anyone or any body part, whether energized or de-energized.
- Except as explained in the Innov-X Manual, do not service the XRF. Failure to heed this warning could result in exposure to radiation or electrical shock.
- Ensure that the proper batteries are placed in the instrument. There is a danger of explosion if improper substitution of batteries is made.
- Do not disengage the “deadman” trigger unless the instrument is set up in the sampling table. When using the XRF in the “hand held” mode it is important that the “deadman” trigger be engaged in order to ensure that the analyzer is attended at all times while x-rays are being emitted.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Innov-X Alpha Series XRF User Manual, Innov-X Systems Inc., August 2005

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Groundwater Well Sampling Procedures

SOP OER-0110

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	7/1/2010	Reformatted, added SOP ID #, and renumbered. Supersedes Revision 0.0. Additional detail provided.	Editorial Technical
Dave Long	2.0	9/21/2016	Revised procedures. Reformatted.	Editorial, Technical

GROUNDWATER WELL SAMPLING PROCEDURES

SOP OER-0110

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1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on sampling of groundwater wells. Groundwater samples give an indication of the nature and extent of any groundwater contamination, and provide data on groundwater quality. Groundwater sampling procedures are generally split into two tasks, purging and sampling. Purging is the process of removing water from the monitoring well prior to sampling and replacing it with groundwater from the adjacent formation. This ensures that a more representative sample of the actual aquifer condition is collected. Every effort must be made to ensure that the sample is representative of the particular zone of water being sampled. These procedures are designed to be used in conjunction with analyses for the most common types of ground water contaminants (i.e., volatile, semi-volatiles, and metals). These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site investigation report.

2.0 SUMMARY OF METHOD

In order to obtain a representative groundwater sample for chemical analysis, it is important to either purge water from the monitoring well or take steps to ensure that only water meeting the data quality objectives (DQO's) and work plan objectives is removed from the well during sampling. Purging is generally performed by removing a pre-determined number of well volumes (well-volume purging), or by removing groundwater until water quality parameters have stabilized. Purging is conducted to remove stagnant water in the well casing and/or immediately adjacent to the well screen before collecting the sample. This may be achieved in a number of ways. Commonly used methods include but are not limited to the use of bailers and submersible pumps. When utilizing submersible pumps, low flow (or low stress) purging/sampling is recommended. Low flow purging/sampling is also highly recommended when sampling for volatile organic compounds (VOC's) and metals. Due to agitation, the tendency to mix formation water with stagnant water above the well screen, and the tendency to stir up fines in the bottom of the well, purging and sampling with a bailer should only be conducted as a last resort. Data is collected under the Voluntary Remediation Program or the UECA pathway to delineate the extent of contamination from sites and to formulate remedial actions utilizing risk based standards; therefore, a high level of data accuracy and validation is required for these programs. As such, groundwater data collected for volatile organic compounds (VOC's) and metals analysis utilizing bailers for purging and sampling may not be accepted in these programs. Note that passive sampling, minimal purge and no-purge methods do not attempt to purge the stagnant water in the well prior to sampling.

When purging, monitoring wells should be purged, at a minimum, the equivalent of three to five times the well volume of standing water or they should continue to be purged until specific conductance, temperature, and pH stabilize. For well-volume purging, the volume of water present in each well shall be computed based on the length of water column and well casing diameter. Once purging is completed, sampling may proceed. Care should be taken when choosing the sampling device as some will affect the integrity of the sample, depending on the

analytical parameters of interest. If information about the contaminant levels in a well is known, then sampling should be performed in a progression from the least to most contaminated well.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The type of sample container, the preservative, holding time, and filtering requirements are all dependent upon the type of analysis to be performed upon the sample. This information should be clearly set forth in the Sampling and Analysis Plan (SAP) for the site. The sampler should consult the SAP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. A pair of clean, new, non-powdered disposable gloves shall be worn each time a different location is sampled to prevent cross-contamination. Samples should be collected directly from the sampling device (i.e. bailer or pump) into appropriate laboratory cleaned containers, without making contact with the sampling device. Samples shall be appropriately preserved, labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold. Refer to Table 2 of this QAPP for information on sample containers, preservation, and holding times for common contaminants.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 General

The goal is to obtain a representative sample of the groundwater. Proper field sampling techniques need to be utilized in order to ensure that a representative sample is collected and the sampler does not compromise the sample through their actions. Analysis can be compromised by field personnel in two primary ways; taking an unrepresentative sample, or by incorrectly handling the sample. There are a number of ways to introduce contaminants into a sample; that is why it is very important to following sampling protocols.

4.2 Purging

In a non-pumping well, there will be little or no vertical mixing of the water, thus stratification will occur. The well water in the screened section will mix with the ground water due to normal flow patterns, but the well water above the screened section will remain isolated, become stagnant, and may lack the contaminants representative of the ground water. Purging prior to sampling will help to ensure that stagnant water is not collected as a part of the sample by either removing the stagnant water above the well screen or by pumping at a low flow rate within the screened interval so as not to mix stagnant water with the formation water.

A non-representative sample can result from excessive pre-pumping of the monitoring well. Stratification of the leachate concentration in the ground water formation may occur, or heavier-than-water compounds may sink to the lower portions of the aquifer. Excessive pumping can dilute or increase the contaminant concentrations from what is representative of the sampling point of interest; therefore, it is important not to over purge a well.

Purging is generally conducted with the use of a pump or a bailer. Two commonly recognized purging methods include the low-stress approach (utilized during low-flow sampling) and the well-volume approach.

The low-stress approach utilizes a variable-speed, low-flow sampling pump. This method is based on the assumption that pumping within the screened zone at a low rate will not draw stagnant water down into the screened portion of the well. Drawdown is minimized during pumping and should not exceed .33 feet (4 inches). Pump placement depends upon the level of water within the well: for water levels above the screened interval, the pump is placed in the middle of the screened interval; for water levels within the screened interval, the pump is placed in the middle (or just below the middle) of the water column. The pump should be gently lowered into the water column. The pump is turned on at a low flow rate (usually ~ 100 ml/min) and increased as necessary until drawdown stabilizes (i.e., pumping rate is equal to or less than well recharge rate). If sampling for VOC's purging flow rate should not exceed 300 ml/min. Water level measurements must be taken frequently to determine drawdown stabilization; once the water level stabilizes, measurements are no longer needed. Water quality indicator parameters (pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity) are monitored approximately every 3-5 minutes after a minimum of one tubing volume (including pump and flow-through cell volumes) has been purged from the well. A flow-through cell allows these parameters to be measured without air contacting the sample prior to the reading for accurate measurements. Once the water quality indicator parameters in Section 7.2 below have stabilized over three successive readings, sampling may begin. Sampling should be conducted as soon as practical after purging and at the same pump level and pumping rate as purging. For VOC's, expected pumping rates are 200-300 ml/min.

The well-volume approach for purging wells is based on proper purging of the stagnant water above the screened interval and the stabilization of water quality indicator parameters. For monitoring wells with water levels above the screen, the pump should be set near the top of the water column and slowly lowered during the purging process, being careful not to expose the screen to air. For water columns within the well screen, the pump should be set below the water table such that drawdown during pumping does not allow air to enter the pump. The pump should not be allowed to draw sediments from the bottom of the well, or produce excessive turbulence due to a high purging rate. A smooth, constant (laminar) flow rate is desired for both purging and sampling. Flow rates should be between 200-500 ml/min (except for VOC's, as noted above). Stabilization requirements still favor the water quality indicator parameters approach (as opposed to a pre-determined well volume), and are consistent with those for the low-stress approach. The parameters should be recorded for each well volume removed; when three successive readings have reached stabilization, sampling may commence. If a groundwater monitoring well has been sufficiently sampled and characterized, and if water quality indicator parameters are no longer needed as part of site characterization and/or monitoring, samples may be obtained based on a specific number of well volumes at the previous pumping rates.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for groundwater well sampling activities:

- Water level indicator
- Photoionization detector (PID)
- Logbook
- Calculator
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Pails, tubs, or buckets
- Plastic sheeting
- Packing materials and Ziploc plastic bags
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water)
- Brushes
- Pails or tubs
- Clean, decontaminated or new unused bailers
- Nylon line, enough to dedicate to each well

6.0 REAGENTS

Reagents may be utilized for preservation of samples and for decontamination of sampling equipment. Refer to the SOP for the decontamination procedures and required reagents. Refer to the site-specific Sampling and Analysis Plan for the preservatives required for the specified analysis to be performed.

7.0 PROCEDURES

7.1 General Procedures

The following general procedures are applicable to all well sampling events.

- a) Place plastic sheeting on the ground in the vicinity of the well to ensure that sampling equipment does not contact the ground surface.
- b) Remove the well cap and check for volatile organics in the headspace using a PID. If concentrations are detected in the headspace above the action levels established in the Site Health and Safety Plan, appropriate personal protective equipment will be required.
- c) Water-level measurement will be made using an electronic water level meter capable of measuring water levels to the nearest .01 foot.
- d) Typically, all depth measurements should be made from the top (the highest point) of the inner well casing (top-of-casing, TOC), also known as the well riser. The reference point location should be described in the field log book and should be used in all subsequent sampling efforts. Check for well damage at each well that could indicate a shift in the

reference point. Lower the water-level measurement tape and gauge the depth to water and total depth of the well. Care should be taken to assure that the water-level measurement device hangs freely in the monitoring well and is not adhering to the wall of the well casing. Take replicate measurements (at least 3) in each well to ensure accuracy. Record water level data in the field logbook. The water level meter should be left in the well during low-flow purging and sampling.

- e) As necessary (depending on the purging/sampling approach), determine the well volume using one of the formulas in Section 8.0 of this SOP. If more than 24 hours have passed since water levels were measured, re-gauge and record the static water level prior to purging.

7.2 Submersible Pump (Low Flow Sampling)

- a) Calculate the total volume in the pump and tubing. Volume estimates per foot for common inside diameter tubing is presented in the following table:

Tubing Inside Diameter (inches)	Tubing Volume (gallon per foot)
1/4	0.0003
3/8	0.0057
1/2	0.010

- b) Connect the pump tubing to the flow-through cell and connect the multi-parameter probe to the cell. Connect the discharge from the flow-through cell to a purge water drum for later IDW disposal. Keep the flow-through cell out of direct sunlight.
- c) Lower the pump slowly in the well to minimize the disturbance of the water column.
- Do not let the pump tubing, electrical cords, and support cable touch the ground as you are lowering the pump into place.
 - Secure the pump at the desired depth using the support cable. The entire pump and tubing assembly should be supported by a stainless steel or Teflon coated cable. It is not advisable to use the tubing to support the pump.
 - Place the pump intake as close to the middle of the screened interval for wells with water levels above the top of the screen. For wells with water levels below the top of the screen, the pump intake should be placed in the middle (or just below the middle) of the water column.
 - The pump or water level probe should not be allowed to hit the bottom of the well before or during sampling because it will disturb sediment. It should be noted that at least three feet of water is needed to implement low flow sampling.
- d) Record the location of the pump intake (feet below TOC) so that future sampling will occur at the same depth interval.
- e) Start the pump at the lowest possible flow setting. Increase the pump rate gradually until a continuous flow is achieved from the discharge tubing. The discharge rate of the pump can be determined by using a graduated cylinder and a stopwatch. Record the

flow rate in gallons per minute. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well. The flow rate should be maintained between 0.03 and 0.13 gallons per minute (.03-.08 gal/min. for VOC sampling) throughout the purging and sampling activities.

- f) When a stable purge rate has been established (i.e., pumping rate is equal to or less than well recharge rate), begin recording water quality readings at a frequency of every three to five minutes.
- g) Continue to purge the well until a minimum of one volume of the tubing plus pump volume have been removed and water quality parameters have stabilized within the following stabilization criteria over three consecutive readings. Record the purging and sampling data in the field logbook.

Parameter	Criteria
pH	+/- 0.1 standard units
Conductivity	+/- 3% of readings
Temperature*	+/- 1.0 degree Celsius
Dissolved Oxygen	+/- 0.3 mg/l or 10% of readings, whichever is greater
Turbidity*	+/- 10% of readings (less than 10 nephelometric turbidity units)
Eh/OORP	+/- 10 millivolts
*Turbidity, which is not an actual water quality indicator, should be measured at the start and end of pumping – low levels are desired, but stabilization isn't necessary. Temperature should be measured, but it is not a water quality indicator, so stabilization isn't necessary.	

- h) Once the water quality parameters have stabilized, collect the ground water sample by detaching the tubing from the flow-through cell. Under no circumstances should the ground water sample be collected from the flow-through cell discharge stream. Collect the samples in the following order:
 - i. Volatile organic compounds (ensure that volatiles are immediately capped and have no headspace)
 - ii. Semi-volatile organic compounds
 - iii. Nitroaromatics
 - iv. Herbicides/pesticides
 - v. Metals
 - vi. All other parameters
- i) Samples for total metals analysis should be collected prior to sampling for dissolved metals. To collect samples for dissolved metals analysis, a 0.45µ filter should be added to the discharge line. Samples for dissolved metals analysis should be collected after 500 ml of water has passed through the in-line filter. Remove the filter following collection of samples for dissolved metals.
- j) Preserve and filter according to the requirements set forth in the site-specific SAP. Label the sample containers using indelible pen, attach a chain-of-custody seal to each container lid, place the containers in plastic bags, and place them on ice in a cooler. Record sample collection date and time. Handle and store samples in accordance with approved QAPP and/or SAP.

- k) Remove the water level meter (if not already removed) and then the pump from the monitoring well. Decontaminate the pump and dispose of the tubing if it is non-dedicated to the well. Protect equipment from contamination by storing on plastic sheeting.
- l) Close and lock the well.
- m) Record the following information in the field log book:
 - Sample ID
 - Location
 - Purging and sampling data
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information

7.3 Bailer Method

[As noted above, bailers are not recommended for most purging/sampling situations, other than in low-permeability formations (see below). If bailers are to be used, justification must be provided in the SAP.]

- a) Purge the well by manually bailing until a minimum of three well volumes have been removed and water quality parameters have stabilized within the following stabilization criteria over three consecutive readings. Record the purging and sampling data in the field logbook.

Parameter	Criteria
pH	+/- 0.1 standard units
Conductivity	+/- 3% of readings
Temperature*	+/- 1.0 degree Celsius
Dissolved Oxygen	+/- 0.3 mg/l
Turbidity*	+/- 10% of readings (less than 10 nephelometric turbidity units)
Eh/OORP	+/- 10 millivolts

- b) Lower bailer slowly and gently into well, do not drop or splash bailer into the water column. Stop lowering at desired point adjacent to well screen. Withdraw a sample from the well, transfer the sample from the bailer directly into sample containers. Preserve and filter according to the requirements set forth in the site-specific SAP.
- c) Collect the samples in the following order:
 - i. Volatile organic compounds (ensure that volatiles are immediately capped and have no headspace)
 - ii. Semi-volatile organic compounds
 - iii. Nitroaromatics

- iv. Herbicides/pesticides
 - v. Metals
 - vi. All other parameters
- d) Samples for total metals analysis should be collected prior to sampling for dissolved metals. To collect samples for dissolved metals analysis, a 0.45 μ filter should be attached to a syringe (or other device to force water through the filter). Samples for dissolved metals analysis should be collected after 500 ml of water has passed through the filter. Discard the filter following collection of samples for dissolved metals.
- e) Label appropriate sampling containers with sampling details and custody information.
- f) Replace the well cap and lock the cover.
- g) Record the following information in the field log book:
- Sample ID
 - Location
 - Purging and sampling data
 - Color
 - Odor
 - Field screening instrument readings (i.e., water quality, PID)
 - Any other pertinent information

7.4 Sampling Wells in Low-Permeability Formations

Wells located in low-permeability formations (i.e., slow-recovery wells, wells that can be purged to dryness, etc.) require alternate sampling procedures than the methods listed above. One approach, for a well screened below the water table, is to remove the stagnant water in the casing to just above the top of the screened interval, to prevent the exposure of the gravel pack or formation to atmospheric conditions. The pumping rate should be as low as possible to minimize disturbance as much as possible in the well. A sample should then be secured from the water within the screened interval. Another approach is to use a dedicated pump located within the screened interval and purge only the pump and tubing volume before collecting the sample (“passive sampling”). Another type of passive sampling uses a passive diffusion bag sampler (PDBS) which is deployed in the screened interval of the monitoring well for two weeks or longer. Analytes of interest passively diffuse into deionized water contained within the sampler as the well equilibrates. It should be noted that only certain VOC’s will diffuse into the PDBS. The PDBS is retrieved from the well and the sample is poured into appropriate sample containers. Other no-purge samplers include equilibrated grab samplers such as the Hydrasleeve and the Snap Sampler. These samplers are deployed in the screened interval of the monitoring well and the well is allowed to equilibrate – equilibration takes only minutes with the Hydrasleeve and days with the Snap Sampler. The Snap Sampler sample comes ready to be shipped to the lab when retrieved; the Hydrasleeve sample must be poured into appropriate

containers before delivery to the lab. Use of these passive sampling and no-purge sampling techniques will require development of an SOP to be included in the SAP.

8.0 CALCULATIONS

If it is necessary to calculate the volume of the well, utilize the following equation:

$$r_b^2 = h$$

Or if the variables are known:

$$r_{ic}^2 h + [(r_b^2 h - r_{oc}^2 h) * ne]$$

Where:

r_{ic}	=	radius inside diameter of casing
r_b	=	radius of borehole
r_{oc}	=	radius outside diameter of casing
h	=	water column height
ne	=	effective porosity of filter pack material (~ 35%)

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAP.
- The collection of an equipment rinsate blank is recommended to evaluate potential for cross-contamination from the purging and/or sampling equipment.
- The collection of duplicate samples will likely be a requirement set forth in the SAP and/or QAPP.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with well sampling:

- Exposure to unknown contaminants
- Lifting injuries associated with moving equipment, coolers with samples, and retrieving pumps and bailers
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE
- Slip, trip, and fall
- Potential electrical shocks associated with use of submersible pumps

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Ground Water Well Sampling, SOP# 2007, US EPA, Environmental Response Team, January 26, 1995

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005, Updated – April, 2011

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Soil Sampling

SOP OER-0120

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	7/1/2010	Reformatted, added SOP ID #, and renumbered. Supersedes Revision 0.0. Combined previous soil sampling SOP for surface and subsurface sampling, added sampling information	Editorial Technical
Dave Long	2.0	9/21/2016	Revised procedures. Reformatted.	Editorial, Technical

SOIL SAMPLING

SOP OER-0120

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1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of surface and subsurface soil samples using equipment such as a continuous flight auger, a split spoon, backhoe, hand auger, shovel, trowel, and/or scoop. Refer to SOP OER-0121 for soil sample collection procedures using direct push (i.e. GeoprobeTM). Analysis of soil samples may determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health or the environment. These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site investigation report. Refer to SOP OER-0122 for procedures for soil sampling of volatiles utilizing Method 5035. Refer to SOP OER-0101 and OER-0102 for procedures for field screening of soil with a photoionization detector (PID) and an X-Ray fluorescence (XRF) detector, respectively.

2.0 SUMMARY OF METHOD

Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type. Surface and near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, continuous flight auger, a split-spoon, or a backhoe.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is generally not performed or recommended, except for Method 5035. However, samples should be cooled and protected from sunlight to minimize any potential reaction. The type of sample container, the preservative (if any), and holding times are all dependent upon the type of analysis to be performed upon the sample. Refer to Table 2 of this QAPP for information on sample containers, preservation and holding times for common contaminants. This information should be clearly set forth in the Sampling and Analysis Plan (SAP) for the site. The sampler should consult the SAP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. A pair of clean, new, non-powdered disposable gloves shall be worn each time a different location is sampled to prevent cross-contamination. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved (if applicable), labeled, custody seals attached and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold. Consider placing each sample container in a zip-lock bag to prevent ice/water in the cooler from dislodging the label and custody seal. (Sample vials and jars for each sample from Method 5035 sampling may be placed in the same zip-lock bag.)

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary potential problems associated with soil sampling: cross-contamination of samples and improper sample collection. Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. Additionally, strictly following decontamination procedures of the non-dedicated sampling equipment can prevent or reduce the chance of cross-contamination problems. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample, significant volatile loss for VOC sample collection or inadequate homogenization of the samples where required, resulting in variable, non-representative results. When sampling with a hand auger, non-cohesive sands may collapse in the borehole prior to reaching the sampling depth; also, in tight clays, the greater the depth attempted, the more difficult it is to recover a sample due to increased friction and torqueing of the hand auger extensions.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil sampling activities. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- Photoionization detector (PID)
- Logbook
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Pails, tubs, or buckets
- Plastic sheeting
- Packing materials and Ziploc plastic bags
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water)
- Brushes
- Sampling gloves
- Shovel
- Spatula, scoops, and/or trowels
- Continuous flight (screw) auger
- Bucket auger
- Post hole auger

- Split spoons
- Drilling rig equipment (points, drive head, drop hammer, puller jack and grip, extension rods, T-handle, thin wall tube sampler, etc.)
- Backhoe

6.0 REAGENTS

Chemical preservation of solids is not generally recommended except for sampling for VOC analysis; therefore, reagents will likely be utilized only for decontamination of sampling equipment. Refer to the SOP for the decontamination procedures and required reagents. Refer to the SOP for Method 5035 for VOC soil sample collection. Refer to the site-specific Sampling and Analysis Plan for the preservatives, if any, required for other specified analyses to be performed.

7.0 PROCEDURES

7.1 General Procedures

- a) Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.
- b) Obtain necessary sampling and monitoring equipment. Ensure that it has been decontaminated since its last use and ensure that the equipment is in good working condition.
- c) Use stakes and/or flagging to identify and mark all sampling locations.
- d) Ensure that WV811 and all local utilities have been called to perform a utility marking of the site.

7.2 Surface Soil Samples

The West Virginia Department of Environmental Protection Office of Environmental Remediation defines surface soil as the soil located from a depth of 0 to 2'. Collection of surface soil samples can be accomplished with tools such as spades, shovels, trowels, and scoops.

- a) Clear any surface debris (e.g., concrete/asphalt, vegetation, roots, gravel/rocks, and twigs) from the sampling location.
- b) Use a scoop, hand-auger, trowel, or shovel to collect a portion of soil from the 0-2' depth. Perform field screening as appropriate (see SOP OER-0101 PID Field Screening). (*Note: Soil samples collected for field soil screening may not be used for laboratory analysis.*) Whenever a vertical or near-vertical surface is sampled, such as when shovels or similar devices are used for surface or subsurface sampling, the surface should be dressed (scraped) to remove smeared soil and to expose a fresh surface for sampling. If Method 5035 is required for volatiles, submerge the coring device directly into a fresh face of the remaining soil contained in the sampling device and collect the sample,

placing the soil in the appropriate sample jar for volatile organic analysis. Note, however, that if the soil is non-cohesive and crumbles when removed from the ground surface, consideration should be given to obtaining the soil plug for Method 5035 analysis directly from a newly exposed ground surface. For all other analysis, the soil may be homogenized in a plastic bag or in a stainless steel bowl prior to placing the soil in the appropriate sample containers. (Note: Remove rocks, pebbles, and organic material from the soil sample prior to placing the soil in the sample containers).

- c) Close the sample containers and affix labels (if not already present) and custody seals to the containers and immediately place on ice.
- d) Measure the depth of the samples using a ruler, and record it in the field logbook.
- e) Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
- f) Record the following information in the field log book:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information

7.3 Sampling at Depth with Hand Augers and Thin Wall Tube Samplers

This system consists of an auger (typically, 4-inch stainless steel auger buckets with cutting heads are used) and/or a thin-wall tube sampler, a series of extensions, and a "T" handle. The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. Perform field screening as appropriate and as referenced in Section 7.2.2 above. Samples for Method 5035 analysis will be collected first, immediately and directly from the auger. Samples for other analysis may then be collected once the material is removed from the auger and homogenized. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler.

The following procedure is used for collecting soil samples with the auger:

- a) Clear the area to be sampled of any surface debris (e.g., twigs, rocks, etc.).
- b) Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
- c) Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole or into a 55-gallon drum. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. Consider using a second, clean auger bucket for sampling once the sampling depth is attained.
- d) After reaching the desired depth, slowly and carefully remove the auger from the hole.
- e) If soil has sloughed from the sides of the auger hole, discard the top 1" of soil in the auger. When sampling directly from the auger, collect the sample after the auger is removed from the hole (note special considerations for Method 5035 sampling above) and proceed to Step k).
- f) Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- g) Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
- h) Remove the tube sampler, and unscrew the drill rods.
- i) Remove the cutting tip and the core from the device.
- j) Discard the top 1" of the core as this may represent material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container.
- k) Perform field screening as appropriate. If Method 5035 is required for volatiles, collect this sample first, submerging the coring device directly into the soil contained in the sampling device and placing the soil in the appropriate sample jar for volatile organic analysis. For all other analysis, the soil may be homogenized in a plastic bag or in a stainless steel bowl prior to placing the soil in the appropriate sample containers.
- l) Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
- m) Record the following information in the field log book:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used

- Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information
- n) Abandon the boring in accordance with applicable state regulations.

7.4 Sampling at Depth with a Split Spoon (Barrel) Sampler

Split spoon sampling is generally used to collect soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. For standard split spoon sampling, a drill rig is used to advance a borehole to the target depth. The drill string is then removed and a standard split spoon is attached to a string of drill rod. The spoon is then lowered to the bottom of the borehole, and a safety hammer is used to drive the split spoon into the soil. After the spoon is filled it is retrieved to the surface, where it is removed from the drill string and opened for sample collection. Continuous split spoon samplers are also common. These are generally larger in diameter and longer in length than standard split spoons. The continuous split spoon is advanced into the soil column inside a hollow stem auger. After the auger string has been advanced into the soil column a distance equal to the length of the continuous sampler being used it is returned to the surface. The sampler is removed from inside the auger and opened for sampling. When split spoon sampling is performed for geotechnical purposes, all work should be performed in accordance with ASTM D1586-98, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils".

The following procedures are used for collecting soil samples with a split spoon:

- a) Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top.
- b) Depending on the type of split spoon being used, the sampler is driven into the soil by the drilling rig, allowing the sample to be collected in the spoon.
- c) As the spoon is being retrieved from the drill string, record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.
- d) Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. Field screening (directly from the spoon) and Method 5035 sampling should be the first tasks performed after opening the spoon to reduce as much as possible the loss of volatiles from the sample. For screening, poke a small hole to the middle of the soil core and take readings with the PID. For all other analysis, the soil may be homogenized in a plastic bag or in a stainless steel bowl prior to placing the soil in the appropriate sample containers. If a split sample is desired, a cleaned, stainless steel knife should be used to

divide the tube contents in half, longitudinally. The standard split spoon sampler is typically available in 2 and 3 1/2 inch diameters. A continuous split spoon sampler may be necessary to obtain the required sample volume depending upon the analysis required.

- e) The amount of soil recovery, blow counts (N-value for Standard Penetration Test), soil type/description, field screening results, sample interval, and depth of any groundwater encountered (first encounter and after boring completion) should all be recorded on the boring log.
- f) Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
- g) Record the following information in the field log book:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information

8. Abandon the boring as necessary in accordance with applicable state regulations.

7.5 Test Pit/Trench Excavation

The following procedures are used for collecting soil samples from test pits or trenches:

- a) Backhoes may be used in the collection of surface and shallow subsurface soil samples. The trenches created by excavation with a backhoe offer the capability of collecting samples from very specific intervals and allow visual correlation with vertically and horizontally adjacent material. Using the backhoe, excavate a trench approximately three feet wide and approximately one-foot-deep below the cleared sampling location. Place excavated soils on plastic sheets. (Note: Trenches greater than five feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.)
- b) A shovel may be used to remove a one to two-inch layer of soil from the vertical face of the pit where sampling is to be done. Remember to dress (scrape) the vertical face if sampling is conducted directly from the trench/pit sidewall, to remove smeared soil from the backhoe bucket and expose a fresh face for screening and sampling. Field screening

may be completed in accordance with SOP OER-0101, as there is plenty of soil available for screening and sampling with test pits and trenches.

- c) Samples may also be taken directly from the backhoe bucket using a shovel, trowel, scoop, or coring device after field screening. Field screening may be completed in accordance with SOP OER-0101. For Method 5035 sampling, submerge the coring device directly into the soil in the backhoe bucket adjacent to the field screening location and collect the sample, placing the soil in the appropriate sample jar for volatile organic analysis. For all other analysis, the soil may be homogenized in a plastic bag or in a stainless steel bowl prior to placing the soil in the appropriate sample containers.
- d) Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
- e) Record the following information in the field log book:
 - Sample ID
 - Location and depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information
- f) Abandon the pit in accordance with applicable state regulations.

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAP.
- The collection of an equipment rinsate blank is recommended to evaluate potential for cross-contamination.

- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAP and/or QAPP for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with these soil sampling procedures:

- Exposure to unknown contaminants
- Lifting and carrying injuries
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE
- Slip, trip, and fall
- Injury from moving equipment
- Underground utilities
- Loud noises.

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Soil Sampling, SOP# 2012, US EPA, Environmental Response Team, February 18, 2000

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005, Update – April 2011

Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, Second Edition, EPA-600/4-84-076, U.S. Environmental Protection Agency, 1984

US EPA Region 4, 2014, *Operating Procedure – Soil Sampling*; SESD PROC-300-R1, U.S. Environmental Protection Agency Region 4, Athens, GA, 24 pp

Soil Sampling Using Direct-Push Drilling

SOP OER-0121

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	7/1/2010	New SOP	Technical

SOIL SAMPLING USING DIRECT-PUSH DRILLING

SOP OER-0121

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1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on soil sampling using direct push (i.e. GeoprobeTM) technology. Surface and subsurface soil sampling supplies information on subsurface lithology as well as providing data for use in evaluating the vertical and horizontal extent of contaminant impact.

These procedures are designed to be used in conjunction with analyses for the most common types of soil contaminants (i.e., volatile, semi-volatiles, and metals). These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site report. Refer to SOP OER-0122 for procedures for soil sampling of volatiles utilizing Method 5035. Refer to SOP OER-0101 and OER-0102 for procedures for field screening of soil with a photoionization detector (PID) and an X-Ray fluorescence (XRF) detector, respectively.

2.0 SUMMARY OF METHOD

Direct-push soil sampling devices are used to collect soil samples at specific depths below ground surface (bgs). Direct-push machines are hydraulically powered and are generally mounted on a customized four-wheel drive vehicle. The base of the sampling device is positioned on the ground over the sampling location and the vehicle is hydraulically raised on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground. A built-in hammer mechanism allows the probe to be driven through dense materials. Maximum depth penetration under favorable circumstances may be greater than 100 feet.

Soil samples are collected using specially designed sample tubes. The sample tube is pushed and/or vibrated to a specified depth. In the simplest sampler, the piston-activated system, the interior plug of the sample tube is removed by inserting small diameter threaded rods. The sample tube is then driven an additional foot to collect the samples. The probe sections and sample tube are then withdrawn and the sample is extruded from the tube. Latch-activated systems are similar to those that use piston-activation mechanisms, but they can collect samples more rapidly. Sampling rates can also be increased by using dual-tube samplers. The dual-tube sampling system is recommended for continuous sampling as the outer casing prevents sloughing and cross-contamination from other depths.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is not generally recommended, except for Method 5035. However, samples should be cooled and protected from sunlight to minimize any potential reaction. The type of sample container, the preservative (if any), and holding times are all dependent upon the type of analysis to be performed upon the sample. This information should be clearly set forth in the Sampling and Analysis Plan (SAP) for the site. The sampler should consult the SAP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. Samples should be collected

directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved (if applicable), labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

A preliminary site survey should be performed in order to identify areas to be avoided with the GeoprobeTM. All underground utilities should be located and marked. These areas where underground utilities are located should be avoided during sampling.

Decontamination of sampling tubes, probe rods, adaptors, non-expendable points and other equipment that contacts the soil is necessary to prevent cross-contamination of samples. During sampling, the bottom portion and outside of the sampling tubes can be contaminated with soil from other depth intervals. Care must be taken to prevent soil which does not represent the sampled interval from being carefully wiped from the outside surface of the sampling tube and the bottom 3 inches of the sample should be discarded before extruding the sample.

Obtaining sufficient volume of soil for analysis of multiple parameters from one sample location may present a problem. Most direct-push soil sampling systems recover a limited volume of soil and it is not possible to reenter the same hole and collect additional soil. When multiple analyses are to be performed on soil samples by this method, it is important that the relative importance of the analyses be identified. Identifying the order of importance will ensure that the limited sample volume will be used for the most crucial analyses. In some instances, it may be appropriate to push another boring very near the initial boring in order to have sufficient soil for all analysis. However, this should be clearly documented in the field notes and in the subsequent report for the site.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil sampling activities. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- Photoionization detector (PID)
- Logbook
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Pails, tubs, or buckets

- Plastic sheeting
- Packing materials and Ziploc plastic bags
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water)
- Brushes
- Sampling gloves
- Direct-push system and associated equipment (i.e., rods, extractor, drive and pull caps, expandable point holders, drive points, piston rods and stops, sample tubes, vinyl end caps)

6.0 REAGENTS

Chemical preservation of solids is not generally recommended; therefore, reagents will likely be utilized only for decontamination of sampling equipment. Refer to the SOP for the decontamination procedures and required reagents. Refer to the site-specific Sampling and Analysis Plan for the preservatives, if any, required for the specified analysis to be performed.

7.0 PROCEDURES

These procedures relate to the sampling activities associated with collecting a soil sample from a Geoprobe™ and are not intended to address in detail the actual operation of the Geoprobe™. The operator should follow the SOP requirements established by the manufacturer for the Geoprobe™ model being utilized at the site. Other direct-push systems with generally similar operating procedures are also available for soil sampling. Ensure that WV811 and all local utilities have been called to perform a utility marking of the site prior to beginning work.

- a) A decontaminated Geoprobe™ sampling spoon with an acetate or clear PVC liner is prepared at the surface and driven into the ground.
- b) The sample spoon is closed on the end with a drive point and advanced to the top of the desired sample interval.
- c) A pin is removed from the top of the sampler and the drive point is lifted out, thereby opening the bottom of the sampler, allowing soil to enter the sample spoon when the spoon is advanced.
- d) The hydraulic hammer advances the Geoprobe™ sampling spoon to fill the acetate liner inside the sampler.
- e) The sample spoon is then retrieved from the hole and the liner extruded from the sampling spoon.
- f) Immediately upon retrieval, the sample is opened, sliced into 6-inch lengths, and field screening with a photoionization detector is conducted. Field screening (directly from the liner) and Method 5035 sampling should be the first tasks performed after opening the spoon to reduce as much as possible the loss of volatiles from the sample. For screening,

poke a small hole to the middle of each 6-inch section of soil core and take readings with the PID. Based on screening results, staining and soil characteristics, a sample interval is quickly selected for volatiles analysis. Once the volatiles sample has been obtained, XRF screening, if applicable, may proceed along with completing boring logs and preparing samples for additional analysis.

- g) Sample intervals to be sent for laboratory analysis are extruded from the acetate liners into the appropriate containers. If volatiles are being sampled, use the Encore or Terra Core samplers (Method 5035) to collect a soil sample directly from the opened acetate sleeve. Refer to the SOP for Method 5035, as needed. Samples that will be analyzed for VOC's should be directly placed into the appropriate sample container without homogenizing or mixing and immediately placed on ice. As appropriate, refer to the SOP for sampling method SW-846 5035. Non-volatile analytes may be placed in a stainless steel bowl or plastic bag and thoroughly homogenized. Fill the appropriate sample containers with the remaining homogenized sample.
- h) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information
- i) Abandon the boring, as needed, in accordance with applicable state regulations.

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAP.

- The collection of an equipment rinsate blank is recommended to evaluate potential for cross-contamination.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAP and/or QAPP for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with soil sampling using direct push technology:

- Exposure to unknown contaminants
- Lifting and carrying injuries
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE
- Slip, trip, and fall
- Injury from moving equipment
- Underground utilities
- Loud noises

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the

OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Geoprobe™ Operation, SOP# 2050, US EPA, Environmental Response Team, March 27, 1996

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005

Model 5400 Geoprobe™ Operations Manual, Geoprobe™ Systems, Salina, Kansas. July, 27, 1990.

US EPA Region 4, 2014, *Operating Procedure – Soil Sampling*; SESD PROC-300-R1, U.S. Environmental Protection Agency Region 4, Athens, GA, 24 pp

US EPA, Contaminated Site Clean-up Information/Characterization and Monitoring/Direct-Push Technologies/Soil and Soil Gas Samplers, Available online at <https://clu-in.org/characterization/technologies/soilandsoilgassamp.cfm>; US Environmental Protection Agency, Washington, DC

Soil Sampling Method 5035

SOP OER-0122

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	7/1/2010	Reformatted, added SOP ID #, and renumbered. Supersedes Revision 0.0. Additional detail provided.	Editorial Technical

SOIL SAMPLING METHOD 5035

SOP OER-0122

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1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on sample collection procedures utilizing Method 5035. The use of Method 5035 for the collection of volatiles samples is required for both the Voluntary Remediation and LUST programs. The procedures in this SOP may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site investigation report.

2.0 SUMMARY OF METHOD

Method 5035 was adopted because of studies showing that sampling according to the previous methods resulted in significant losses of selected volatile organic compounds (VOCs). Method 5035 incorporates chemical preservatives and sample storage techniques to limit volatilization and biodegradation of VOCs. There are two collection options for Method 5035: an airtight coring device such as the Encore® sampler, or preserved vials (Terra Core™). The collection method determination should be based on holding time, laboratory-processing considerations, soil type (calcareous soils have special considerations when using the preserved vial option), and shipping considerations. Samples for VOC analysis are not homogenized.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Samples collected with the Encore® Sampler do not require preservation other than being cooled to $\leq 6^{\circ}\text{C}$, but without freezing the sample. These samples should be extracted by the laboratory within 48 hours of the samples being collected. Samples collected by the Terra Core™ Method undergo chemical preservation. Three 40 ml vials are utilized in the Terra Core™ sampling method. Two of the vials have sodium bisulfate and the third has methanol as the preservative. After soil collection and preservation, the Terra Core™ samples should also be cooled to $\leq 6^{\circ}\text{C}$, but without freezing the sample. Terra Core™ samples should be extracted by the laboratory within 14 days of the samples being collected.

The type of sample container, the preservative (if any), and holding times should be clearly set forth in the Sampling and Analysis Plan (SAP) for the site. The sampler should consult the SAP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved (if applicable), labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Holding times for samples collected with the Encore® sampling equipment is 48-hours. This creates the need for overnight shipment and/or hand delivery to the laboratory. It also requires immediate attention to the samples by the analytical laboratory.

When using the Terra Core™ Sampling method, calcareous soil samples may react upon contact with sodium bisulfate solution in the pre-preserved sample vial, causing VOC loss through effervescence and potential failure of the VOA vial septum through pressure buildup. Additionally, when soil samples are highly calcareous in nature, the sodium bisulfate preservative solution may not be strong enough to reduce the pH of the aqueous solution to below 2.0, potentially rendering the preservative useless.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil sampling activities. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- Encore® Sampler
- Terra Core™ sampler
- Sample containers (Encore® air tight container or Terra Core™ which will consist of 40-ml vials with appropriate preservative and stirring bar), plus additional minimum 2 oz. glass jar to collect sample for dry weight determination
- Photoionization detector (PID)
- Logbook
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Packing materials
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water)
- Brushes
- Sampling gloves
- Plastic bags

6.0 REAGENTS

The Terra Core™ vials should come pre-prepared from the laboratory with the proper chemical preservatives (sodium bisulfate and methanol). Reagents for the decontamination of non-disposable sampling equipment used to collect the soil samples will be required. Refer to the SOP for the decontamination procedures and required reagents.

7.0 PROCEDURES

7.1 Encore® Sample Collection Method

- a) Clear any surface debris (e.g., vegetation, rocks, twigs) from the sampling location.
- b) Before taking the sample, hold the coring body and push plunger rod down until small o-ring rests against tabs. This will assure that plunger moves freely.
- c) Depress locking lever on Encore® T-Handle. Place coring body, plunger end first, into open end of T-Handle, aligning the (2) slots on the coring body with the (2) locking pins in the T-Handle. Twist coring body clockwise to lock pins in slots. Check to ensure sampler is locked in place. Sampler is ready for use.
- d) Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle viewing hole. Remove sampler from soil. Wipe excess soil from coring body exterior.
- e) Cap coring body while it is still on T-handle. Push cap over flat area of ridge. Push and twist cap to lock arm in place. Cap must be seated to seal sampler.
- f) Remove the capped sampler by depressing locking lever on T-Handle while twisting and pulling sampler from T-Handle. Lock plunger by rotating extended plunger rod fully counter-clockwise until wings rest firmly against tabs.
- g) Place the capped sampler back into the Encore® sample zipper bag and label. Seal the bag and put on ice. Samples collected with the Encore® method should be analyzed within 48 hours or preserved by the laboratory within 48 hours. Collect sample for dry-weight determination in 2-oz. glass jar. This container should be air tight (septum lid) but should not contain any preservative. Place this sample in the cooler with the Encore® samples.
- h) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information

7.2 TerraCore™ Sampling Method

- a) A determination of whether the sample will be considered high (>200 µg/Kg) or low (0.5-200 µg/Kg) concentration should be performed. This may be based on DQOs, expected concentrations, or regulatory limits. If the expected concentrations cannot be estimated prior to sampling, and/or DQOs or other considerations indicate the need for both concentration levels, both low and high concentration aliquots should be collected. Refer to the Table below for appropriate sample containers for high/low sample concentrations.

Sample Container and Preservative Requirements for Samples Collected by the TerraCore™ Method			
Concentration of Volatiles	<200 ug/kg	>200 ug/kg	Unknown Concentrations
Solid Type			
Non-Reactive	3-40 ml vials with 5 ml of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of methanol weight checked to the nearest 0.01gram ¹
Reactive	3-40 ml vials with 5 ml of organic free reagent water weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of organic free reagent water weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹
Unknown	3-40 ml vials with 5 ml of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of organic free reagent water weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹	3-40 ml vials with 5 ml of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of organic free reagent water weighed to the nearest 0.01gram ¹ AND 3-40 ml vials with 5 ml of methanol weighed to the nearest 0.01gram ¹
¹ The vials will be pre-weighed by the laboratory to the nearest 0.01gram. If the required weight check is performed in the field, a variance of up to 0.2 grams is allowed. If the required weight check is performed in the laboratory, a variance of up to 0.01 gram is allowed. Weight checks should be performed within 24 hours of use.			

- b) Prior to adding solid to any vial, the individual vial should be checked to ensure that the weight of the vial and preservative have been written on the vial by the laboratory.
- c) Clear any surface debris (e.g., vegetation, rocks, twigs) from the sampling location.
- d) Have ready a 40ml glass volatile organic analysis (VOA) vial containing the appropriate preservative. With the plunger seated in the handle, push the Terra Core™ into freshly

exposed soil until the sample chamber is filled. A filled chamber will deliver approximately 5 grams of soil.

- e) Wipe all soil or debris from the outside of the Terra Core™ sampler. The soil plug should be flush with the mouth of the sampler. Remove any excess soil that extends beyond the mouth of the sampler.
- f) Rotate the plunger that was seated in the handle top 90° until it is aligned with the slots in the body. Place the mouth of the sampler into the 40ml VOA vial containing the appropriate preservative, and extrude the sample by pushing the plunger down. Quickly place the lid back on the 40ml VOA vial. Repeat steps 4-6 for additional sample vials as necessary.

Note: When capping the 40ml VOA vial, be sure to remove any soil or debris from the threads of the vial.

- g) Place the containers in a plastic bag and seal. Store sample on ice at approximately 4°C. Collect sample for dry-weight determination in 2-oz. glass jar. This container should be air tight (septum lid) but should not contain any preservative. Place this sample in the cooler with the Terra Core™ sample vials. Deliver the cooler to the laboratory.
- h) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.

- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAP.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAP and/or QAPP for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAP and/or QAPP for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAP or QAPP shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAP and/or QAPP.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing work environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAP and/or the Site Safety and Health Plan (SSHP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the potential hazards associated with this SOP.

- Exposure to unknown contaminants
- Exposure to chemical reagents and preservatives
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE
- Slip, trip, and fall

Material safety data sheets should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection,
August 2005

Test Methods for Evaluation of Solid and Hazardous Wastes, SW 846 Method 5035, US
Environmental Protection Agency, Washington, DC 1998.

US EPA Region 4, 2014, *Operating Procedure – Soil Sampling*; SESD PROC-300-R1, U.S.
Environmental Protection Agency Region 4, Athens, GA, 24 pp

APPENDIX C: WV CSR TITLE 47, SERIES 32

**TITLE 47
LEGISLATIVE RULE
DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATER RESOURCES**

**SERIES 32
ENVIRONMENTAL LABORATORIES CERTIFICATION AND STANDARDS OF
PERFORMANCE**

§47-32-1. General.

1.1. Scope. -- This rule governs the certification of laboratories conducting environmental analysis of waste and wastewater performed as required by rules or orders issued pursuant to the covered statutory programs. The rule establishes the provisions for obtaining and maintaining laboratory certifications and the criteria and procedures laboratories will be required to follow in analyzing samples.

1.2. Authority. -- W. Va. Code §22-1-15.

1.3. Filing Date. -- May 12, 2009.

1.4. Effective Date. -- July 1, 2009.

1.5. Incorporation by Reference. -- The Department hereby adopts and incorporates into this rule the approved "Guidelines Establishing Test Procedures for the Analysis of Pollutants" 40 CFR 136, EPA SW 846 Methods, and such other methods as may be approved by U.S. Environmental Protection Agency (EPA) or the Secretary.

1.6. Construction. -- This rule shall be liberally construed to permit the Department to discharge its statutory functions and to effectuate the purposes of the laboratory certification program.

1.7. Purpose of this Rule. -- This rule is promulgated to ensure that the results of environmental analyses are accurate, reproducible and verifiable. This purpose will be achieved by:

1.7.1. Establishing the administrative procedures to be followed by certified laboratories and laboratories seeking certification;

1.7.2. Establishing the categories in which, and the parameters for which laboratories may be certified;

1.7.3. Establishing the minimum requirements, criteria and procedures for laboratory equipment and supplies, practices, methodology, quality control, personnel, facilities, data reporting, and laboratory and record maintenance, which a certified laboratory shall continually meet; and

1.7.4. Establishing the enforcement procedures the Department will follow to ensure that all certified laboratories or laboratories seeking certification are in compliance with this rule.

1.8. Certification Program Requirements.

1.8.1. A laboratory analyzing samples for compliance with adopted rules, permits, or orders issued pursuant to a covered statutory program will follow the procedures set forth in this rule in order to obtain

and maintain certification. The provisions of this rule are only applicable to tests required by State and Federal regulatory programs.

1.8.2. Certified laboratories and laboratories seeking certification will analyze all samples requiring testing under this rule in accordance with the procedures and methods required by this rule.

1.9. Program Information and Communications. -- Questions concerning the requirements of this rule should be directed to the Department of Environmental Protection, Division of Water and Waste Management, Quality Assurance Program, 601 57th Street SE, Charleston, WV 25304-2345.

§47-32-2. Definitions.

The following words and terms, when used in this rule have the following meanings unless the context clearly indicates otherwise.

2.1. "Accredited" means an approval conferred upon institutions or programs where appropriate by a nationally recognized accrediting agency or association as determined by the Department.

2.2. "Accuracy" means the closeness of agreement between an observed value and the accepted reference value. Accuracy is best determined through the analysis of a sample spiked with a known concentration of target analytes and this value compared to an unspiked aliquot.

2.3. "Analyte" means an element, ion, isotope, compound, or component of interest to the analyst.

2.4. "Analytical Reagent Grade" (AR), "ACS reagent grade", and "Reagent Grade" are synonymous terms for reagents which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

2.5. "Analyst" means the individual who performs the analytical methods and associated techniques and who is responsible for applying the required laboratory practices and quality controls to meet the required level of quality.

2.6. "APHA Standard Methods" or "Standard Methods for the Examination of Water and Wastewater" means the methods published by the American Public Health Association, 1015 Fifteenth Street NW, Washington, DC 20005.

2.7. "Approved analytical methods" are those analytical or test methods cited in the Code of Federal Regulations as being approved by EPA or such other methods as shall be approved by the Secretary.

2.8. "Batch" means the environmental samples that are prepared or analyzed together using the same procedures, personnel, lots of reagents, and standards.

2.9. "Batch, Analytical" means a batch composed of prepared environmental samples that are analyzed together as a group. An analytical batch may contain samples originating from various environmental matrices and can exceed 20 samples.

2.10. "Batch, Preparation" means a batch composed of 1 to 20 environmental samples of the same matrix with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours.

2.11. "Cancellation" means the voluntary removal of a previously certified laboratory from the laboratory certification program.

2.12. "Category" means a group of parameters for which certification is offered.

2.13. "Certification" means the approval granted by the Secretary authorizing a laboratory to provide environmental compliance data.

2.14. "Certification parameter" means a parameter that is identified in a proficiency test sample and that is used to evaluate the overall analytical performance of a laboratory on the specific method.

2.15. "Certification year" is that period of time following the date upon which the laboratory first receives certification for any parameter or category and lasting for 365 consecutive days.

2.16. "Certified thermometer" is a thermometer that has documentation from the manufacturer showing that it has been compared against a National Institute for Standards Testing (NIST) thermometer covering the temperature ranges employed by the laboratory.

2.17. "CFR" means the Code of Federal Regulations.

2.18. "Compliance analysis" means the analysis of a sample that is required to be analyzed by a Department rule, permit or order.

2.19. "Covered statutory programs" means one of the regulatory programs developed under statutory authority of one of the following acts of the Legislature:

2.19.1. Water Pollution Control Act, W. Va. Code §22-11-1.

2.19.2. Hazardous Waste Management Act, W. Va. Code §22-18-1.

2.19.3. Hazardous Waste Emergency Response Fund Act, W. Va. Code §22-19-1.

2.19.4. Underground Storage Tank Act, W. Va. Code §22-17-1.

2.19.5. Solid Waste Management Act, W. Va. Code §22-15-1.

2.19.6. Groundwater Protection Act, W. Va. Code §22-12-1.

2.20. "Deficiency" means a deviation from acceptable procedures or practices.

2.21. "Department" means the West Virginia Department of Environmental Protection.

2.22. "EPA" and "USEPA" means the United States Environmental Protection Agency.

2.23. "Laboratory" means a facility conducting tests or analyses of parameters for which certification is required, where the results of such tests or analyses are used for purposes of demonstrating compliance under the covered statutory programs. Provided; The term "laboratory" shall not include individuals conducting analyses of constituents that must be conducted in the field because of practical constraints; such as, but not limited to pH, dissolved oxygen, total residual chlorine and sulfide.

2.24. "Laboratory pure water" means distilled or deionized water which is free of contaminants that

interfere with analytical tests.

2.25. "Laboratory seeking certification" means an uncertified laboratory which has submitted an acceptable application and the appropriate fee.

2.26. "List of certified parameters" means the document displaying the categories and parameters for which a laboratory is certified.

2.27. "Matrix or matrices" means the media of an environmental sample, either non-potable water or solid and chemical materials.

2.28. "Method" means the scientific technique used to perform testing or analyses of an environmental sample.

2.29. "Mobile laboratory" means a portable enclosed structure within which testing or analyses of environmental samples occurs.

2.30. "NPDES" means National Pollutant Discharge Elimination System.

2.31. "Nonpotable water" means wastewater, ambient water, surface water, groundwater, effluents, water treatment chemicals, and toxicity characteristic leaching procedure or other extracts.

2.32. "Parameter" means an analytical method or test within a category and for which certification is offered.

2.33. "Proficiency test sample" means a sample containing a known amount of a specific or combination of parameters used in part to evaluate the performance of a laboratory.

2.34. "Person, Persons, or applicant" means any industrial user, public or private corporation, institution, association, firm or company organized or existing under the laws of this or any other state or country; state of West Virginia; governmental agency, including federal facilities; political subdivision; county commission; municipal corporation; industry; sanitary district; public service district; drainage district; soil conservation district; watershed improvement district; partnership; trust; estate; person or individual; group of persons or individuals acting individually or as a group; or any legal entity whatever.

2.35. "Personal and direct supervision" means that a supervisor is available either in person or on call at all times when laboratory procedures are being performed.

2.36. "Precision" means the agreement among a set of measurements performed on duplicate samples without assumption of knowledge of the true value. Precision is estimated by means of duplicate/replicate analyses.

2.37. "Quality Assurance Program" means a program developed to achieve the purposes of subsection 1.7 for the covered statutory programs of the Department.

2.38. "Quality Manual" means the document stating, or making reference to the policies, objectives, principles, responsibilities, accountability, implementation plans, methods, operation procedures, or other documents of an environmental laboratory for ensuring the quality of its testing analyses.

2.39. "Raw Data" means that data acquired in the process of collecting and analyzing samples for

compliance testing purposes. Raw data includes such sampling report forms, sample log books, laboratory bench sheets, calculations and formulas, and analytical data and notes as are used during sample analysis. Raw data may be in the form of graphs, line recorder charts, handwritten data, or computer printouts made at or near the time of the analysis or sample collection.

2.40. "Revocation of certification" means the action taken by the Department to halt the certification of a laboratory for cause.

2.41. "Sample Duplicate" means a sample prepared by dividing a homogeneous sample into separate parts so that each part is also homogeneous and representative of the original sample.

2.42. "Secretary" means the Secretary of the West Virginia Department of Environmental Protection or his or her designee.

2.43. "Solid and Chemical Materials" means soils, sediments, sludges, solid waste, drill cuttings, overburden, minerals, coal ash, and products and by-products of an industrial process that result in a matrix that is not otherwise defined.

2.44. "Standard Operating Procedure" means a written document that provides detailed instructions for the performance of all aspects of test analyses, operation, or action.

2.45. "Suspension of certification" means the temporary removal of approval to perform analyses under this rule until such time as the basis for suspension is rectified.

2.46. "Supervisor" means that designated person responsible for the technical adequacy and quality of data for a certification category, and who possesses the qualifications required under subsection 3.7.

§47-32-3. Certification Program; Application, Procedures, and Requirements.

3.1. Requirements of Certification.

3.1.1. With the exception of those tests not normally performed in a laboratory proper, all sample analyses required by order of the Department or performed for the purpose of determining compliance with chemical, microbiological, aquatic toxicity and radiological requirements of the State's covered statutory programs must be performed in laboratories certified for this purpose pursuant to this rule. Analyses performed in laboratories not so certified shall not be accepted by the Department as being in compliance with the requirements, rules or orders of the Department. All analyses not performed in a laboratory proper must be performed by personnel under the direction of a supervisor from a certified laboratory.

3.1.2. Laboratories doing business in other states where a state certifying agency grants reciprocal certification, approval, or other authorization to laboratories located in West Virginia, and which is certified, approved or authorized by the agency of that state having primary certification responsibility under Federal programs delegated to such other state under conditions equivalent to those required by this rule, are considered to be certified for the purpose of this rule once they have complied with the provisions of Section 3.4. Laboratories doing business in other states where certification is not required, and who are not certified in another state, may be considered for certification by following the conditions and requirements stated in Section 3.3.

3.1.3. Only laboratories certified pursuant to this rule or maintained by the EPA may be called West Virginia Certified Environmental Laboratories and no laboratory may adopt any name or make any

oral or written statement intended or likely to mislead the public with respect to its certification status.

3.2. Categories of Certification. -- A laboratory applying for certification in one or more of the following categories must demonstrate acceptable performance on proficiency test samples for all matrices, where available, and meet all other requirements of this rule. The laboratory certificate, including the list of certified parameters, will specify the categories and the parameters within each category for which the laboratory is certified and it must be displayed in a location visible to the public. Tests for all categories, except Aquatic Toxicity, must be conducted in accordance with the method and procedures specified in the Code of Federal Regulations, Chapter 40 as applicable or other methods that may be approved by EPA or the Secretary. The certification categories are:

3.2.1. Nonpotable Water Trace Metals;

3.2.2. Nonpotable Water Inorganic Nonmetals;

3.2.3. Nonpotable Water Volatile Organic Chemicals;

3.2.4. Nonpotable Water Extractable and Semi-volatile Organic Chemicals;

3.2.5. Nonpotable Water Dioxin and Dibenzofuran;

3.2.6. Nonpotable Water Microbiology, comprising tests for Coliform Bacteria, Fecal Streptococci, Pathogenic Bacteria, Plate counts, Viruses, Parasites and Parasite ova;

3.2.7. Whole Effluent Toxicity, testing which must be conducted in accordance with the methods and procedures specified in 40 CFR 136;

3.2.8. Nonpotable Water Radiochemistry;

3.2.9. Hazardous Waste Characteristics, including Corrosivity, Ignitability, Reactivity, Extraction Procedure Toxicity, and Toxicity Characteristic Leaching Procedure, or other tests or analyses designated by the Secretary;

3.2.10. Solid and Chemical Trace Metals;

3.2.11. Solid and Chemical Inorganic Nonmetals;

3.2.12. Solid and Chemical Volatile Organic Chemicals;

3.2.13. Solid and Chemical Extractable and Semi-volatile Chemicals;

3.2.14. Solid and Chemical Dioxin and Dibenzofuran;

3.2.15. Solid and Chemical Microbiology; and

3.2.16. Solid and Chemical Radiochemistry.

3.3. Application Procedures and Requirements for Laboratories Located in West Virginia.

3.3.1. A person operating a laboratory in West Virginia who wants to be certified in one or more

of the categories and parameters thereof or, who if already certified, wants to add a category or a parameter within a category, must apply for certification to the West Virginia Department of Environmental Protection, Quality Assurance Program, refer to subsection 1.9 for the address. The applicant shall submit the appropriate fee with the application for certification.

3.3.2. An application for certification is acceptable when a complete application is submitted. This includes the appropriate fee, and the information requirements of this rule for the category, categories or parameter(s) for which certification is requested. Acceptance of a complete application does not authorize the laboratory to perform analyses regulated by this rule. The applicant will be notified if the application is not acceptable and the laboratory inspected to determine if it is in compliance with the requirements of this rule prior to the issuance of certification.

3.3.3. An application will be rejected without prejudice for not being a complete application.

3.3.4. Proficiency test samples will be an element of the laboratory evaluation. Proficiency testing will be in accordance with subsection 3.10. The laboratory must receive acceptable scores on two separate proficiency test studies prior to an on-site inspection being performed. Certified laboratories that desire to include additional parameters within previously certified categories must demonstrate satisfactory results for proficiency test samples for these additional parameters.

3.3.5. The results of the analysis of proficiency test samples shall be considered in determining whether the certification of the laboratory should be granted, renewed, denied, revoked, or suspended. Certification may be granted only for those parameters for which the laboratory performs acceptably.

3.3.6. An applicant for certification who either does not perform acceptably on the proficiency test samples or does not otherwise meet the requirements of this rule shall be notified that the requirements for certification have not been met.

3.3.6.a. Applicants receiving a notification that certification requirements have not been met may not reapply for certification until the laboratory assures the Quality Assurance Office in writing that corrective actions have been taken and documented that bring the laboratory into compliance with this rule.

3.3.6.b. Owners, principal officers, managers or supervisors of a laboratory, for which certification has been denied, may not reapply for certification of this same facility by simply changing the company or laboratory name.

3.3.6.c. Certification is transferrable. A laboratory facility must notify the Department in writing at the address listed in subsection 1.9 that the facility is being sold or has a change of principal officer(s), manager(s) or supervisor(s) within 30 days of the change or activity.

3.3.7. Certifications may contain conditions requiring correction of minor deficiencies identified by the Quality Assurance Officer by a date or dates specified therein.

3.4. Application Procedures and Requirements for Laboratories Not Located in West Virginia.

3.4.1. Owners of laboratories located in a state other than West Virginia, which have been certified, approved or otherwise authorized by that state's agency having primary certification, approval or authorization responsibility for laboratory certification programs with conditions equivalent to those required by this rule, and who have entered into a reciprocity agreement with West Virginia, and who wish to perform analyses covered by this rule for West Virginia clients shall:

3.4.1.a. Annually complete the application form provided by the Department's Quality Assurance Office;

3.4.1.b. Have the form certified by the state agency having primary certification authorization/enforcement responsibility; and

3.4.1.c. Return the form to the Quality Assurance Office of West Virginia at the address listed in subsection 1.9.

3.4.2. The application will be reviewed and if found to be complete the laboratory will be certified or recertified.

3.4.3. If the laboratory's certification, approval or authorization is revoked by the state agency having primary certification, approval or authorization responsibility, the West Virginia certification is automatically canceled for the same parameter(s) as has been revoked in the other state. The laboratory manager shall notify the West Virginia Quality Assurance Office and all clients in West Virginia of the revocation within 48 hours of receipt of notice of revocation.

3.4.4. The owner of a laboratory in a state other than West Virginia which is not certified by that state or is certified under conditions not equivalent to those required by this rule and who wishes to perform analyses for West Virginia clients may apply for certification in accordance with the procedure set forth in subsection 3.3 of this rule. In addition, prior to conducting the on-site laboratory inspection, the laboratory shall submit to the Quality Assurance Office a per diem sum the Department determines to be sufficient to cover the travel, room, and board expenses of the certification inspector(s).

3.5. Renewal of Certification. -- Applications for renewal of certification must be submitted, on forms provided therefore, no later than 180 days before the expiration date of certification, and accompanied by the appropriate fee. A laboratory submitting an application for renewal of certification may continue to operate under the previous certification until the Quality Assurance Office notifies the laboratory of the approval or denial of renewal.

3.6. Fees.

3.6.1. Owners of Laboratories applying for certification or renewal of certification, shall submit the appropriate fee obtained from the annual fee schedule specified in Table 1 for each category in which the laboratory seeks certification for one or more parameters, along with the required application materials. Fees are nonrefundable.

3.6.2. Laboratories owned or operated by the State of West Virginia or an agency of the Federal Government are exempt from the above fees, except in situations addressed in paragraph 3.6.2.a, but shall make appropriate application for certification in accordance with the other provisions of this rule.

3.6.2.a. In situations where a laboratory under this subdivision is conducting analyses for a fee, an appropriate certification fee will be assessed.

3.6.3. All application fees collected under this rule will be paid into a special state treasury fund designated the "Environmental Laboratory Certification Fund" which will be used to defray the cost of administering this rule.

3.7. Required Laboratory Personnel Qualifications.

3.7.1. Each laboratory must have one individual designated as the person responsible or in charge and irrespective of any local title or designation, is herein referred to as the laboratory manager.

3.7.2. Current employee records must include a resume documenting each employee's training, degrees held, experience, duties, and date(s) of relevant employment. This provision is applicable only to the employee's laboratory and environmental sampling work history. Table 2 lists the minimum education and experience requirements.

3.7.3. Laboratory supervisors who are also laboratory technicians and who do not have the required laboratory experience will be considered a Supervisor-in-Training and must have their work reviewed by an individual meeting the above education and experience requirements for supervisors.

3.7.4. Technicians holding a West Virginia Environmental Training Center Wastewater Laboratory Technician certificate meet the education and experience requirements of this rule only in the conduct of analyses while employed at a Publicly Owned Treatment Works (POTW).

3.8. Duties and Responsibilities of Laboratory Personnel.

3.8.1. The laboratory manager or his designee will administer the operations of the laboratory including the approval of test and analytical results.

3.8.2. Each laboratory supervisor shall provide personal and direct supervision for personnel and for the reporting of test and analytical results.

3.9. Management of Laboratories.

3.9.1. A certified laboratory may offer as a service those laboratory tests, analyses, or procedures that are within the category or categories for which it is certified.

3.9.2. A laboratory that is certified shall only report test and analytical data for samples which are properly labeled, and for which there is reasonable assurance the samples have been collected, preserved, stored and transported in such a manner as to assure identity, stability of the sample, and proper analysis.

3.10. Proficiency Testing.

3.10.1. Except when determined by the Quality Assurance Office that an appropriate performance evaluation test is not readily available, all certified laboratories or laboratories seeking certification shall participate in a proficiency testing program covering all tests, matrices, and analyses made available within the category, categories or parameter(s) for which the laboratory is certified or seeks certification. The laboratory must participate in two studies per certification year at a frequency of one study every six (6) months.

3.10.2. Each certified laboratory or laboratory applying for certification must obtain proficiency test samples from an approved provider for each parameter and matrix for which certification is requested. The list of approved providers is located at <http://www.a2la.org/dirsearch/nelacptproviders.cfm>.

3.10.3. Laboratories certified or those seeking certification must test or analyze the proficiency test samples and submit the results to the Quality Assurance Office or its authorized agent, as appropriate,

within the time frame allowed each participant testing that set of samples for evaluation.

3.10.3.a. A laboratory may not send proficiency test samples to another laboratory for testing.

3.10.3.b. A laboratory shall not knowingly receive proficiency test samples from any laboratory seeking certification or certified by this office.

3.10.3.c. A laboratory shall not discuss proficiency test sample data with any other laboratory for any purpose.

3.10.3.d. Any laboratory found in violation of 3.10.3a, 3.10.3.b, or 3.10.3.c will be denied certification and not allowed to reapply for certification for a period of five (5) years from the date of the denial.

3.10.4. The laboratory will have satisfied the requirements for testing for a parameter when it receives an 'Acceptable' evaluation for that parameter, in two of the last three proficiency test studies.

3.10.5. The laboratory will be informed of the results of each evaluation by the proficiency test provider. For those parameters which a laboratory has not successfully completed the proficiency test after three attempts, the laboratory will be reevaluated upon written request.

3.10.6. Acceptance limits for proficiency tests will be established according to the USEPA document "National Standards for Water Proficiency Testing, Criteria Document." For analytes and matrices not found in this document, limits will be established in accordance with the procedures set forth by the current National Environmental Laboratory Accreditation Conference (NELAC).

3.10.7. The laboratory will have three separate opportunities to acceptably analyze proficiency test samples for any parameter for which the laboratory seeks certification. The laboratory need only repeat proficiency tests for those parameters for which the laboratory has failed to perform acceptably. Parameters for Organic Samples shall mean a method, or method subdivision (i.e. Volatiles, Extractables, BTEX, etc.). Laboratories that fail to successfully analyze two of three different sets or rounds of proficiency test samples in the time period allotted will not be certified for the failed parameters until two consecutive sets or rounds have been successfully analyzed.

3.10.8. This rule incorporates by reference the 2003 National Environmental Laboratory Accreditation Conference (NELAC) Proficiency Testing standard, Chapter 2 with appendices for the purposes of Proficiency Testing Criteria for Laboratory Certification.

3.11. Laboratory Inspections.

3.11.1. As a condition of obtaining and maintaining certification, a laboratory will permit and facilitate inspections by personnel of the Department. This inspection will include the physical facilities as well as laboratory records and reports.

3.11.2. The Department will conduct at least one on-site inspection of a laboratory seeking certification to determine whether or not the laboratory meets the Quality Assurance Office standards as set forth in this rule.

3.11.3. Regular inspections of laboratories certified in accordance with this rule will be conducted during reasonable hours. These inspections will be conducted annually or as determined by the Secretary,

however, in no situation may more than two years elapse between inspections.

3.11.4. Authorized representatives of the Department may make inspections of a certified laboratory whenever the Department in its discretion considers such inspections necessary. A laboratory's refusal to allow entry to the Department's representative will be grounds for denial or revocation of certification.

3.11.5. During inspections, consideration will be given to staff competence, working conditions, tests or analytical methods used, quality control procedures, quality assurance programs, maintenance of records and compliance with the requirements of this rule.

3.11.6. The laboratory will be furnished with a copy of the inspection report which will list deficiencies found.

3.12. Cancellation, Suspension, and Revocation of Certification.

3.12.1. Any certified laboratory may cancel its certification in any category or parameter by notifying the Quality Assurance Office in writing of the laboratory's decision to cancel its certification. This cancellation notification will not entitle the laboratory to any refund of fees paid.

3.12.1.a. If the laboratory wishes to cancel the entire certification, all categories and parameters, the laboratory will enclose its Environmental Laboratory Certificate with the letter of notification.

3.12.2. A laboratory's certification may be suspended for failure to correct deficiencies within the specified timeframe.

3.12.3. A laboratory's certification may be suspended for failure to correct proficiency test sample failures.

3.12.4. A laboratory's certification may be revoked if the laboratory commits any falsification relating to certification, testing, or reporting of analytical results or for failing to comply with the provisions in 3.10.

3.13. Effect and Duration of Suspension and Revocation.

3.13.1. The results of any tests or analyses performed after the effective date of a suspension or revocation order for any category or parameter will not be accepted by the Department as being in compliance with the requirements of the Covered Statutory Programs as defined in subsection 2.20.

3.13.2. Suspension or revocation will not be withdrawn until the basis for the suspension or revocation has been eliminated or rectified.

3.13.3. Any laboratory having its certification suspended or revoked must notify all clients of the suspension or revocation.

3.14. Notice of Changes -- In the event there are any changes in the name, location, ownership, address, telephone number or supervisory personnel of the laboratory to which the provisions of this rule apply, then the laboratory will immediately submit written notice thereof to the Department. For supervisory personnel this provision applies only to those whose responsibilities include analyses that must

be made in compliance with this rule.

§47-32-4. Laboratory Requirements.

A certified laboratory or a laboratory seeking certification must continually meet and follow the requirements of this section.

4.1. Laboratories will have on the premises and under the control of the laboratory manager all of the equipment and instruments necessary to analyze each parameter in which the laboratory is certified, or is seeking certification. All equipment must meet the minimum standards required by the test method used.

4.2. General Requirements for All Laboratories.

4.2.1. Adequate laboratory space and facilities, to include equipment and instruments must be available to properly carry out the services performed in the laboratory.

4.2.2. Laboratory work areas will be arranged so as to minimize problems in contamination, transportation and communication.

4.2.3. Workbench space within the laboratory must be ample for the tests or analyses to be performed, have adequate lighting and be convenient to a sink, water, gas, vacuum and electrical outlets or other utilities as necessary to properly carry out the specific tests or analyses to be performed.

4.2.4. Temperature and humidity within the laboratory are to be maintained within the limits required for the proper performance of each test or analysis, the proper operation of the various instruments, and the proper storage of expendable supplies.

4.2.5. pH meters must have an accuracy of and scale graduations within 0.1 standard unit.

4.2.6. Analytical and pan balances are to be clean, not corroded, and be provided with Class-S weights or equivalent. Analytical balances will be capable of weighing to 0.1 milligram minimum. Pan balances will be capable of weighing to 100 milligrams.

4.2.6.a. An analytical balance must be mounted on a heavy, shockproof table. The balance level must be checked each use and adjusted as necessary;

4.2.6.b. An analytical balance must be located in an area that is not near laboratory traffic and is protected from drafts and humidity changes; and

4.2.6.c. Three Class-S or equivalent weights are to be available for checking the analytical balance. These weights must cover the range expected to be encountered during routine analyses.

4.2.7. All temperature measuring devices will be graduated in one degree Celsius (or 2 degrees Fahrenheit) increments and readable to 0.5 degrees Celsius (1 degree Fahrenheit) for all analyses except fecal coliform analysis; in which case glass or metal thermometers are to be readable to 0.2 degrees Celsius.

4.2.7.a. Continuous temperature recording devices will be sensitive and accurate to within 1.0 degree Celsius (2 degrees Fahrenheit).

4.2.7.b. The column of liquid in glass thermometers will have no separation.

4.2.7.c. Liquid column in glass and electronic type thermometers without a current manufacturer's certificate of accuracy must be verified as accurate annually. All other types, to include Automatic Temperature Compensation (ATC) devices, must be verified as accurate quarterly. Verification must be accomplished by comparison to a certified thermometer traceable to a National Institute for Standards Testing thermometer. See also paragraph 5.2.2.g for additional thermometer requirements.

4.2.7.d. Each temperature measuring device must be uniquely identified. The results of accuracy verifications must be documented. The corrected temperature must be recorded whenever temperatures are required to be recorded.

4.2.8. Sample storage refrigerators must maintain an internal temperature of ≤ 6 degrees Celsius.

4.2.9. Laboratory glassware, plastic ware, and metal utensils will meet the following requirements:

4.2.9.a. Glassware and metal utensils must resist corrosion, and be capable of withstanding high temperatures, and vigorous cleaning;

4.2.9.b. Flasks, beakers, dilution bottles, culture dishes, culture tubes and other glassware are to be of borosilicate glass and free of chips, cracks, and excessive etching;

4.2.9.c. Volumetric glassware must be Class A and need not be calibrated before use. Non Class A glassware must be calibrated before use; and

4.2.9.d. Metal utensils must be made of stainless steel or other inert material.

4.2.10. Pipettes must meet the following requirements:

4.2.10.a. Glass pipettes are to be made of borosilicate glass;

4.2.10.b. Plastic pipettes must be compatible with the reagents being measured, i.e. will not dissolve or show signs of etching or numbers being removed;

4.2.10.c. Plastic pipettes must be sterile or sterilizable for microbiological procedures;

4.2.10.d. Pipettes must deliver the required volume quickly and accurately within a 2.5 percent tolerance; and

4.2.10.e. Pipettes must not be excessively etched, nor the mouthpiece or delivery tips chipped, or the graduation marks illegible.

4.2.11. Magnetic stirrers must have variable speeds, and use Teflon coated stirring bars.

4.2.12. Volumetric dispensing devices including autopipetors, autotitrators and digital burets must be of sufficient sensitivity for the application. Delivery volumes of mechanical volumetric dispensing devices must be checked using the gravimetric method or using Class A volumetric glassware once every 3 months.

4.2.13. All purchased reagents and solutions must be certified as appropriate for the intended use by the manufacturer or supplier or must be verified as appropriate by the laboratory prior to use.

4.3. Criteria and Procedures for Trace Metal Testing.

4.3.1. The Department incorporates methods approved in 40 CFR §136.3 Table IB, the current approved edition of EPA publication SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, and other methods as may be approved by EPA or the Secretary, including all standards, criteria, sample collection procedures, analytical procedures, methodology, quality assurance and quality control specifications for evaluation and certification purposes.

4.4. Criteria and Procedures for Inorganic Nonmetals.

4.4.1. The Department incorporates methods approved in 40 CFR §136.3 Table IB, the current approved edition of EPA publication SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, and other methods as may be approved by EPA or the Secretary, including all standards, criteria, sample collection procedures, analytical procedures, methodology, quality assurance and quality control specifications for evaluation and certification purposes.

4.5. Criteria and Procedures for Volatile Organic Chemicals, Extractable and Semi-volatile Chemicals and Dioxin and Dibenzofuran.

4.5.1. The Department incorporates methods approved in 40 CFR §136.3 Table IC, ID and IG, the current approved edition of EPA publication SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, or such other methods as may be approved by EPA or the Secretary, including all standards, criteria, sample collection procedures, analytical procedures, methodology, quality assurance and quality control specifications for evaluation and certification purposes.

4.6. Criteria and Procedures for Microbiological Testing.

4.6.1. The Department incorporates from methods approved in 40 CFR §136.3 Table IA, or other methods as may be approved by EPA or the Secretary, including all standards, criteria, sample collection procedures, analytical procedures, methodology, quality assurance and quality control specifications for evaluation and certification purposes.

4.6.2. Laboratory pure water for use in microbiological examinations will be analyzed for the parameters listed in Table 3. Should the test results for any of the substances exceed the standards set forth in the table, corrective action must be taken and the water retested.

4.6.2.a. Analysis of laboratory pure water for use in microbiological examinations must be performed by a laboratory certified under this rule. Results must be maintained and include the date, type of analysis, results and identity of the individual responsible for the results.

4.6.2.b. For purchased laboratory pure water for use in microbiological examinations, a current certificate of analysis from the producer is required, documenting that the purity of the water is traceable. The purchased laboratory pure water must meet the requirements of Table 3.

4.7. Criteria and Procedures for Whole Effluent Toxicity Testing.

4.7.1. All work is to be performed in accordance with procedures outlined in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, EPA/821/R-02/012, or Short Term Methods for Estimating Chronic Toxicity of Effluents and Receiving

Waters to Freshwater Organisms, EPA/821/R-02/013 and other methods as may be approved by EPA or the Secretary for the test to be performed.

4.8. Criteria and Procedures for Radiochemistry Testing.

4.8.1. The Department incorporates methods approved in 40 CFR §136.3 Table IE, the current approved edition of EPA publication SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, or other methods as may be approved by EPA or the Secretary, including all standards, criteria, sample collection procedures, analytical procedures, methodology, quality assurance and quality control specifications for evaluation and certification purposes.

4.9. Criteria and Procedures for Characteristics Testing.

4.9.1. The Department incorporates the current approved edition of EPA publication SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, and other methods as may be approved by EPA or the Secretary, including all standards, criteria, sample collection procedures, analytical procedures, methodology, quality assurance and quality control specifications for evaluation and certification purposes.

§47-32-5. Methodology, Quality Control and Record Keeping.

5.1. Methodology.

5.1.1. Sample collection, handling, and preservation techniques specified in 40 CFR §136.3 Table II, or other procedures approved by EPA or the Secretary are to be followed.

5.1.1.a. Samples requiring preservation will be preserved in accordance with 40 CFR §136.3 Table II for compliance with subsection 2.19.1 and the NPDES. All other samples will be preserved in accordance with applicable methods and regulations.

5.1.1.b. Sample collection, handling and preservation techniques specified by the analytical methods will be followed for the parameters analyzed by those methods in the absence of guidance under paragraph 5.1.1.a.

5.1.1.c. The chain of custody form must be completed at the time of sample collection and will state the sampling location, date and time of collection, collector's name, type(s) of preservation, number of containers per sample, type of sample (grab or composite) and any remarks.

5.1.1.d. After the sample has been collected, the appropriate information as to identity of the sample is to be written on the label. The identity of the sample must be the same on the label and the chain of custody form. The label must remain affixed to the sample container and is not to be removed until the required analyses have been completed and the surplus sample has been discarded.

5.1.1.e. The chain of custody must accompany the sample at all times. Custody of the sample must be documented on the chain of custody throughout the life of the sample (from collection to disposal of surplus sample after all required analyses have been completed). Any time the custody of the sample is transferred from one person to another, except analysts in the same laboratory, this transfer must be documented in the appropriate fields on the chain of custody form.

5.1.1.f. Immediately upon delivery of the sample to the laboratory, the individual delivering

the sample will complete the appropriate section(s) of the chain of custody form. A chain of custody form is not required where the sampler is also the analyst and in situations where the laboratory and the sample site(s) are within the property boundaries of the facility in which the laboratory is located.

5.1.1.g. Prior to accepting custody of a sample, laboratory personnel must be reasonably assured that the sample has met the chemical and temperature preservation requirements. If the sample fails to meet these requirements, the sample chain of custody form is to be marked indicating the sample was improperly preserved. Analytical data resulting from improperly preserved samples must be accompanied by a statement indicating the condition of the sample upon receipt by the laboratory. Analytical data resulting from samples improperly preserved will not be accepted as being in compliance with this rule.

5.1.1.h. When it is necessary to send samples by mail, bus, courier service, or private shipping, the chain of custody form is to be completed by the individual relinquishing custody of the sample for shipping and is to accompany the samples during shipping. Upon receipt of the samples in the laboratory, the provisions of paragraph 5.1.1.g are to be followed.

5.1.2. Test procedures identified in 40 CFR §136.3, EPA publication SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods or other methods approved by EPA or the Secretary will be utilized for the analysis of all samples required to be reported to the Department.

5.1.2.a. All procedures other than those set forth in subdivision 5.1.2 are considered alternate test procedures (ATP). Laboratories must make special application to the Department for the use of ATPs in accordance with 40 CFR §136.4.

5.1.2.b. All laboratories which have previously been granted approval to use an ATP by the EPA will be allowed to continue using such method after submitting written proof of the approval to the Department.

5.1.3. General Laboratory Practices.

5.1.3.a. Chemistry -- Inorganic Nonmetals and Trace Metals.

5.1.3.a.A. Laboratories utilizing visual comparison devices must calibrate the standards incorporated into devices of this type at least once every four months. The laboratory will make and maintain records of the date and method of each calibration.

5.1.3.a.B. Distilled and deionized water is to have a resistivity value ≥ 0.5 megohms-cm at 25 degrees Celsius.

5.1.3.a.C. Analytical Reagent grade chemicals should be used for most analyses. Detailed information on reagent grades is set forth in the approved analytical methods and their recommendations must be followed for the reagent quality to be used for each test or analysis.

5.1.3.a.D. Where applicable, method detection limits must be determined for all categories and parameters. The method found in 40 CFR Part 136, Appendix B must be used for this calculation.

5.1.3.a.E. Field blanks must be prepared and analyzed for the test categories and parameters identified in subdivisions 3.2.1 and 3.2.2, at a minimum of two times per year, once during the cold wet season and once during the warm dry season.

5.1.3.a.F. Field duplicates must be collected and analyzed for the test categories and parameters identified in subdivisions 3.2.1, 3.2.2, 3.2.10, and 3.2.11, at a minimum of two times per year, once during the cold wet season and once during the warm dry season.

5.1.3.b. Microbiology.

5.1.3.b.A. All practices and procedures for the conduct of microbiological examinations must follow the guidance in methods approved in 40 CFR §136.3 Table IA.

5.1.3.b.B. The temperature of incubators, water baths and heat blocks must be monitored in accordance with approved methods or as specified by regulation.

5.1.3.b.B.1. Each incubator, water bath or heat block must have a thermometer placed so as to give a representative temperature measurement for the device.

5.1.3.b.B.2. Incubators, water baths and heat blocks must be clean and properly maintained in accordance with the manufacturer's instructions.

5.1.3.b.C. Autoclaves must meet the specified temperature tolerances in the approved method. The use of a pressure cooker is not recommended.

5.1.3.b.C.1. A continuous temperature recording device or a maximum temperature registering thermometer must be used to measure the temperature during each autoclave cycle.

5.1.3.b.C.2. The laboratory must use a sterilization verification technique such as autoclave tape to indicate proper sterilization of equipment and contaminated materials.

5.1.3.b.C.3. Autoclaves must be clean and properly maintained in accordance with the manufacturer's instructions.

5.1.3.b.C.4. Autoclaves must be serviced annually by a qualified person. Servicing must include a pressure check and calibration of temperature devices.

5.1.3.b.D. Hot air sterilization ovens must be of sufficient size to prevent crowding and constructed to give uniform sterilization.

5.1.3.b.D.1. Hot air sterilization ovens must be clean and properly maintained according to the manufacturer's instructions.

5.1.3.b.E. Appropriate optical counting equipment must be used in accordance with approved methods.

5.1.3.b.F. Appropriate inoculating equipment must be used in accordance with approved methods.

5.1.3.b.G. Appropriate membrane filters, pads and dishes must be used in accordance with approved methods.

5.1.3.b.H. A sterility blank must be analyzed:

5.1.3.a.F. Field duplicates must be collected and analyzed for the test categories and laboratory;

5.1.3.b.H.2. with each lot of membrane filters, pads and dishes;

5.1.3.b.H.3. with each lot or batch of sample containers, either purchased or prepared in the laboratory;

5.1.3.b.H.4. with each lot or batch of rinse/dilution water, either purchased or prepared in the laboratory; and

5.1.3.b.H.5. with each lot or batch of culture tubes, either purchased or prepared in the laboratory.

5.1.3.b.I. Field blanks must be prepared and analyzed for the test categories and parameters identified in subdivision 3.2.6, at a minimum of two times per year, once during the cold wet season and once during the warm dry season.

5.1.3.b.J. Field duplicates must be collected and analyzed for the test categories and parameters identified in subdivision 3.2.6, at a minimum of two times per year, once during the cold wet season and once during the warm dry season.

5.1.3.b.K. All equipment and reagents must be sterilized prior to use. All contaminated equipment must be sterilized prior to reuse. All contaminated material must be rendered innocuous prior to disposal.

5.1.3.c. Whole Effluent Toxicity Testing.

5.1.3.c.A. Natural or artificial sources of water may be used, but natural sources are preferred.

5.1.3.c.B. Natural sources are to be free of pollution, low in turbidity, high in dissolved oxygen, low in B.O.D., and the pH must be favorable to the maintenance of the organisms.

5.1.3.c.C. Municipal water supplies are acceptable. Water from a municipal source must be passed through a filter to remove organic chemicals and chlorine before use, and be conditioned for the species under test.

5.1.3.c.D. Test organisms are to be fed as outlined in the approved methods, subdivision 3.2.7.

5.1.3.c.E. Treatment of diseased or parasitized organisms is to be in accordance with the procedures given in the approved methods, subdivision 3.2.7.

5.1.3.c.F. Organisms treated for disease or parasites are not to be used in whole effluent toxicity tests for at least 10 days after treatment.

5.1.3.d. Radiochemistry.

5.1.3.d.A. Analytical reagent grade (AR) chemicals will be used for all analyses, unless

otherwise required for an individual analytical procedure.

5.1.3.d.B. Radioactive standards and radioactive wastes are to be stored in an enclosed and properly labeled area, either within the laboratory or in a separate room or facility. All radioactive materials must be safely stored in suitable containers.

5.1.3.d.C. Standards and samples are to be prepared in an area of the laboratory specifically designated for and exclusively used for the preparation of radioactive standards and samples. Adequate precautions must be taken in this area to ensure against radioactive contamination.

5.1.3.e. Volatile Organic, Extractable, and Semi-volatile Organic Testing. Equipment must be capable of meeting the quality control requirements specified in subdivision 5.2.6.

5.1.3.e.A. Trip blanks must be prepared, transported and analyzed for each batch of samples for analysis for Nonpotable Volatile Organic Chemicals, subdivision 3.2.3.

5.1.3.e.B. A method blank must be analyzed with each batch of samples.

5.1.3.e.C. A laboratory control sample must be analyzed with each batch of samples.

5.1.3.e.D. A matrix spike and a matrix spike duplicate must be analyzed with each batch of samples. In situations where the laboratory does not receive sufficient sample volume or quantity to perform a matrix spike and a matrix spike duplicate, a laboratory control sample and a laboratory control sample duplicate must be analyzed.

5.1.3.e.E. Surrogate spike compounds must be added to all samples and quality control standards prior to preparation/extraction and analysis where applicable. The recovery of surrogate compounds must be compared to acceptance limits established in the appropriate method. If acceptance limits are not provided in the method, the laboratory must use appropriate procedures to establish in-house acceptance limits.

5.1.3.e.F. Any time criteria are not met with respect to blanks, laboratory control samples, matrix spikes, matrix spike duplicates, or surrogates, data must be reported with appropriate qualifiers describing the situation and explaining the effect on the results.

5.2. Quality Control Programs -- Each laboratory will develop, and have on file available for inspection a written description of the current laboratory Quality Assurance Program Plan. This written description will outline the procedures the laboratory uses in meeting the quality control requirements set forth in this subsection. Managers, supervisors, and analysts should participate in developing the Quality Assurance Program Plan. Each participant within the laboratory is to have access to a copy of the quality control program Quality Assurance Program Plan and the detailed guidelines for implementation of the participant's responsibility. A record of analytical control tests and quality control checks on media, materials, and equipment will be prepared by the laboratory and retained for at least three years.

5.2.1. A written description includes, but need not be limited to, the following for each category:

5.2.1.a. Procedures which the laboratory will use in meeting the quality control requirements of this rule pertaining to laboratory equipment and instrumentation, and the frequency with which these procedures will be performed.

5.2.1.b. Each laboratory will develop and maintain a written standard operating procedure (SOP) manual, which sets forth, in detail, the methods the laboratory will use in chemical analyses or tests for all parameters for which the laboratory is seeking certification.

5.2.1.c. Each laboratory must record and retain all raw data and calculations derived from analyses and quality control procedures in a manner that will provide easy verification of the data and calculations during on-site inspections.

5.2.2. Laboratories conducting analyses for Inorganic Nonmetals and Trace Metals must perform the following internal quality control checks:

5.2.2.a. Each analytical balance, with the exception of electronic balances without internal calibration controls, is to be checked and adjusted annually by a balance service technician. The accuracy of each analytical balance must be checked on each day of use using at least three Class-S weights covering the range expected to be encountered during routine analysis. The weights used, weight detected, dates on which checks were performed, analyst, record of balance level check and other pertinent information is to be recorded in a log book. The daily weighing check will be used as an indication of proper operation of electronic balances.

5.2.2.b. The accuracy of the wavelength setting of spectrophotometers without built-in automatic system diagnostics is to be checked yearly by comparing the wavelength setting to the absorption maxima appropriate standards. Any observed variation of the wavelength setting from the expected value must be within the manufacturer's stated tolerance for the instrument. The check data must be recorded in a logbook.

5.2.2.c. pH meters are to be calibrated prior to use with two pH buffer standards bracketing the value to be measured and the calibration recorded. Records of pH meter standardization must be maintained in a laboratory notebook that documents the date of standardization, calibration buffers used and the initials of the individual conducting the standardization. If the meter displays a slope or other indicator of performance, this information must also be recorded.

5.2.2.c.A. Aliquots of standard buffers may not be used for longer than one day.

5.2.2.d. The linearity of conductivity meters must be checked over the range of the instrument using at least five concentrations of standard solutions yearly. The cell constant, k , is to be determined from this data. The meter must be calibrated using at least one standard with each use. The results of these calibrations must be recorded in a log book.

5.2.2.e. A daily record of the drying oven temperature must be maintained for each day on which the drying oven is in use. The oven thermometer must be kept in a sand bed or other inert material.

5.2.2.e.A. The oven temperature must be recorded immediately prior to placing samples in the oven and then again immediately prior to removing samples at the end of the drying cycle.

5.2.2.f. The temperature of each refrigerator and each incubator is to be either recorded continuously or recorded daily from in-place thermometers immersed in liquid and placed on one of the shelves being used. The refrigerator thermometer must be kept in a low vapor pressure liquid such as 50/50 water/Ethylene Glycol.

5.2.2.g. The accuracy of all thermometers used to monitor temperatures will be verified by

comparing the readings of such thermometers with the readings of a certified thermometer. Refer to paragraphs 4.2.7.c and 4.2.7.d.

5.2.2.h. A calibration curve must consist of one calibration blank and 4 at least four standards to be prepared for each analysis requiring a calibration curve. This curve will be verified prior to each subsequent analysis by analyzing at least one calibration blank and one standard at or near the midpoint of the curve. These verifications are considered satisfactory if the result for the calibration blank is less than the method detection limit and the result for the midpoint standard is within 10 per cent of the expected value following vendor approved procedures for instrument calibration.

5.2.2.i. Standard curves used in the analysis of parameters in the Trace Metals category will be prepared in accordance with approved methods.

5.2.2.j. Where practicable, duplicate sample analyses are to be conducted for parameters in the Inorganic Nonmetals and Trace Metals categories to verify the precision of the method. Duplicate analyses will be performed at a frequency of 5 percent. Where less than 20 samples are analyzed at one time the analyst is to verify the precision once per analysis batch. Documentation will be made, in tabular form and on control charts, of precision testing.

5.2.2.j.A. In cases where sample results are normally below the method detection limit, precision must be determined by analysis of matrix spikes and matrix spike duplicates.

5.2.2.k. Where practicable, spiked sample analyses will be conducted to verify the accuracy of the method at the same frequency as set forth in paragraph 5.2.2.j of this rule. Documentation will be made, in tabular form and on control charts, of accuracy testing.

5.2.2.l. Where practicable, standard deviations are to be calculated and documented for all applicable measurements being conducted in the Inorganic Nonmetals and Trace Metals categories (spiked sample recoveries). Standard deviations must be documented in tabular form and on control charts.

5.2.3. Microbiology.

5.2.3.a. A start and finish membrane filter (MF) sterile control test of rinse water, media and supplies will be conducted for each sample filtration series. If the control tests indicate contamination, then all data which has been generated through tests involving the use of the contaminated materials will be rejected and the laboratory must request immediate resampling of those samples associated with the observed contamination.

5.2.3.b. When analyzing duplicate aliquots to assess precision, the same series of volumes/dilutions must be utilized for the sample and the duplicate.

5.2.3.c. The method detection limit for bacteria by the membrane filter method is defined as 1 colony /100 ml, adjusted as necessary for filtered volumes other than 100 ml.

5.2.3.d. The most probable number (MPN) test for bacteria must be carried through the "confirmed" stage for Fecal Coliform.

5.2.4. Whole Effluent Toxicity Testing -- An acceptable degree of precision for definitive toxicity tests is the 95 percent confidence level or fiducial intervals within less than ± 30 percent of the 48 hour or incipient LC50 value.

5.2.4.a. Five reference toxicant tests on each reference toxicant and species combination evaluated by the laboratory are to be performed to establish the validity of effluent toxicity data generated by bioassay laboratories.

5.2.4.a.A. After completion of the requirements in paragraph 5.2.4.a, a reference toxicant test must be performed each month in which whole effluent toxicity testing is conducted using the same method and species as used for the whole effluent toxicity testing.

5.2.4.b. Quality control and proficiency test samples are available from commercial sources.

5.2.4.c. The reference toxicant test must be conducted within 7 days immediately preceding a whole effluent toxicity test or concurrently with the whole effluent toxicity test.

5.2.4.d. A control chart, as described in approved methods, should be prepared for each reference toxicant/species combination, and successive LC-50's plotted and examined to determine if the results are within prescribed limits.

5.2.4.e. If the LC-50 of a reference toxicant does not fall in the expected range for the test organisms, the sensitivity of the test system is suspect. In this case, the test procedure should be examined for defects, and a different batch of test organisms should be employed in repeating the reference toxicant and effluent toxicity test.

5.2.5. Radiochemistry -- Permanent records must be maintained of preventive maintenance, periodic inspections, testing, and calibration for the proper operation of radiation instruments and analytical balances; validation of methods; evaluation of reagents and volumetric equipment; surveillance of results; and remedial actions taken in response to detected defects. Such records must be kept on file by the laboratory for a period of at least five years.

5.2.5.a. To verify internal laboratory precision, duplicate analyses equal to ten percent of sample analyses shall be performed. The differences between duplicate measurements shall be less than twice the standard deviation of the specific analysis as described in Environmental Radioactivity Laboratory Intercomparison Studies Program, EPA 600/4-77-001 and other guidance from EPA or the Secretary.

5.2.5.b. One background and one calibration standard must be tested each day at a 5 percent level or fraction thereof.

5.2.5.c. Work records of quantitative tests are to indicate final results together with all corresponding instrument readings and calculations. Where instrumentation produces tracings or printouts, such tracings or printouts may serve as the work record.

5.2.6. Volatile Organic, Extractable and Semi-volatile Organic Testing.

5.2.6.a. The frequency and procedures for satisfying each of the requirements listed in paragraphs 5.2.6.b and 5.2.6.c are described in detail in EPA publication SW-846, 40 CFR Part 136, and/or in the US EPA Contract Laboratory Program Statement of Work for Organics Analysis.

5.2.6.b. Minimum quality control operations necessary to satisfy the analytical requirements associated with the determination of semi-volatile and volatile organic compounds by gas chromatographic methods will include the following:

5.2.6.b.A. Evaluation of Appropriate Blank Materials.

5.2.6.b.B. Surrogate Spike Response Monitoring.

5.2.6.b.C. Matrix Spike and Duplicate Analyses or Matrix Spike Duplicate.

5.2.6.b.D. Verification of Response and Calibration.

5.2.6.b.E. Conformational Analysis.

5.2.6.c. Minimum quality control operations to satisfy the analytical requirements associated with gas chromatographic/mass spectrometry determinations of semi-volatile and volatile compounds will be as follows:

5.2.6.c.A. Documentation of GC/MS Mass Calibration and Tune Abundance Patterns.

5.2.6.c.B. Documentation of GC/MS Response Factor Stability.

5.2.6.c.C. Internal Standard Response and Retention Time Documentation.

5.2.6.c.D. Surrogate Spike Recovery Monitoring

5.2.6.c.E. Matrix Spike and Duplicate Analyses or Matrix Spike Duplicate.

5.3. Records and Data Reporting.

5.3.1. Records of analyses, including but not limited to all raw data, calculations, quality control data, and laboratory reports, are to be kept by the laboratory for at least five years unless otherwise specified.

5.3.2. The following information is to be retained by the laboratory as part of the records of analysis and the records of custody:

5.3.2.a. The laboratory number or other form of identification of the sample;

5.3.2.b. The chain of custody form as required under paragraph 5.1.1.c;

5.3.2.c. The date and time when the laboratory received the sample, whether the sample was received preserved or unpreserved;

5.3.2.d. The date and time of analysis of the sample;

5.3.2.e. The person or persons who performed the analysis;

5.3.2.f. The type of analysis performed and the analytical method or methods employed;

5.3.2.g. The raw data generated by the analysis and results of the analysis; and

5.3.2.h. The name and address of the laboratory to which the sample was forwarded, if the analysis was not performed at the laboratory which first received the sample.

5.3.3. If the chain of custody information is reported on a chain of custody form, a copy of the form must be attached to the sample report form.

5.3.4. The results of each analysis are to be calculated and entered on the sample report form which is to be forwarded to the person requesting the analysis of the sample. A careful check is to be made to assure that each result entered on the sample report form is the same as the result generated by the analysis and entered on the bench sheet or other raw data document.

5.3.5. The original or true duplicate of the results of the test or analysis is to be sent promptly to the person who requested such tests or analysis, and must be signed by the laboratory manager or a designee whose designation has been documented in the laboratory Quality Assurance Manual or other instrument describing pertains within the laboratory.

5.3.6. Whenever a laboratory subcontracts samples to another laboratory, the person ordering the examination is to receive the original laboratory report or a true duplicate of that report on the form generated by the subcontract laboratory that actually performed the test or analysis.

5.3.7. If results are entered into a computer storage system, a printout of the data must be verified with the raw data.

5.3.8. The final data report must contain the following:

- 5.3.8.a. The name, address, and contact information of the laboratory performing the analyses;
- 5.3.8.b. Sample identification number (unique identifier assigned by the laboratory);
- 5.3.8.c. Sample description;
- 5.3.8.d. Date sample was collected;
- 5.3.8.e. Date sample was received at the laboratory;
- 5.3.8.f. Date of each individual analysis;
- 5.3.8.g. Method detection limit for each parameter;
- 5.3.8.h. Identity of the test method(s);
- 5.3.8.i. Deviations from the test method, if applicable;
- 5.3.8.j. Disclosure of contract laboratory and original or true copy of the results from the contract laboratory; and
- 5.3.8.k. Identity of the responsible agent.

§47-32-6. Appeals.

Appeal to Environmental Quality Board -- Any person aggrieved or adversely affected by an order or action of the Secretary made and entered in accordance with the provisions of this rule or by issuance or denial of certification under the provisions of this rule, may appeal to the Environmental Quality Board in

the same manner as appeals are taken under W. Va. Code §22B-1-7 to have the order vacated or modified. The filing of a notice of appeal will not automatically stay an order or action of the Secretary. The Environmental Quality Board will be reimbursed from the Environmental Laboratory Certification Fund for expenses incurred for appeal hearings filed with the Board relative to the provisions of this rule.

TABLE 1:

ENVIRONMENTAL LABORATORY CERTIFICATION
ANNUAL FEE SCHEDULE

Application fee – initial application.....	\$100.00
Application fee – renewal application	\$80.00
Application fee – additional parameters/methods	
When added other than at renewal	\$50.00
Nonpotable water Trace Metals – per metal – one method	\$20.00
Each additional method for the same metal	\$10.00
Nonpotable water Inorganic Nonmetals – per analyte or parameter – one method.....	\$50.00
Each additional method for the same analyte or parameter	\$25.00
Nonpotable water Volatile Organic Chemicals – per method	\$250.00
Per category maximum	\$750.00
Nonpotable water Extractable and Semi—volatile Organic Chemicals – per method	\$250.00
Per category maximum	\$750.00
Nonpotable water Dioxin and Dibenzofuran	\$1000.00
Nonpotable water Microbiology – per parameter per method	\$75.00
Whole Effluent Toxicity – acute	\$750.00
Whole Effluent Toxicity – chronic	\$750.00
Nonpotable water Radiochemistry.....	\$600.00
Solid and Chemical Trace Metals – per metal – one method	\$20.00
Each additional method for the same metal	\$10.00
Solid and Chemical Inorganic Nonmetals – per analyte or parameter – one method	\$50.00
Each additional method for the same analyte or parameter	\$25.00
Solid and Chemical Volatile Organic Chemicals – per method	\$250.00
Per category maximum	\$750.00
Solid and Chemical Extractable and Semi-volatile Organic Chemicals – per method.....	\$250.00
Per category maximum	\$750.00
Solid and Chemical Dioxin and Dibenzofuran	\$1000.00
Solid and Chemical Microbiology – per parameter per method	\$75.00
Solid and Chemical Radiochemistry.....	\$600.00
Hazardous Waste Characteristics – per procedure.....	\$150.00

TABLE 2:

EDUCATION & EXPERIENCE REQUIREMENTS
FOR SUPERVISORS

CERTIFICATION CATEGORY	EDUCATION + (Years)(1)		EXPERIENCE (Years)(2)	SPECIAL REQUIREMENTS
Limited Chemistry & Microbiology	12 14 16	+ + +	2 or 1 or 1	ETC Certificate(3)
Atomic Absorption absorption	16	+	2(4)	2 years of experience must be in atomic
Gas Chromatography	16	+	2(4)	2 years of experience must be in gas chromatography
Mass Spectrometry experience spectrometry	16	+	2(4)	2 years of must be in mass
Whole Effluent Toxicity	16	+	2(4)	2 years of experience must be in whole effluent toxicity testing
Radiochemistry	16	+	2(4)	2 years of experience must be in radiochemistry

Notes:

(1) 12 years = High School diploma or GED.

14 years = 2 years of college with emphasis in laboratory technology or a natural science.

16 years = Bachelors degree in Chemistry, Biology, Environmental Science, or other natural science.

(2) Substitution -- 1 year of laboratory experience within the specific certification category may be used for each year of education beyond 12 years.

(3) ETC Certificate = Environmental Training Center Laboratory Technician Certificate required of all POTW laboratory supervisors.

(4) No substitution is allowed for the 2 years of minimum experience required.

TABLE 3:

QUALITY OF PURIFIED WATER USED IN MICROBIOLOGY TESTS

Test	Monitoring Frequency	Limit
<i>Chemical Tests</i>		
Conductivity	With each use	>0.5 megohms resistance or <2 umhos/cm at 25 degrees Celsius
pH	With each use	5.5 - 7.5
Heavy Metals (Cd, Cr, Cu, Ni, Pb, Zn) (single) (total)	Annually Annually	<0.05 mg/L <0.10 mg/L
Ammonia/Organic N	Monthly	<0.10 mg/L
Total Chlorine Residual	With each use	< detection limit (0.01 mg/L maximum, whichever is lower)
Total Organic Carbon	Monthly	<1.0 g/L
<i>Bacteriological Tests</i>		
Heterotrophic Plate Count	Annually	<1000 colonies/mL

APPENDIX D: OER INSPECTION FORMS AND CHECKLISTS

LUST Incident Report



WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF ENVIRONMENTAL REMEDIATION **INCIDENT**
REPORT

☐ Confirmed Release
☐ Suspected Release
☐ Complaint

Date: _____ Time: _____
Callen Name: _____
Phone #: _____

FACILITY ID# _____ LEAK ID# _____ INVESTIGATOR: _____
LOCATION NAME: _____ STREET: _____
CITY: _____ STATE: _____ COUNTY: _____ ZIP: _____
PHONE: (____) _____ OPERATOR: _____
WERE TANKS LAST USED AFTER DECEMBER 22, 1998? ☐ Yes ☐ No
SPECIFIC LOCATION: _____

PRIORITY CODE: 10 2 ☐ 3 ☐ (1 BEING HIGHEST) CLOSURE#: _____
.65 LETTER REQUIRED: YES ☐ NO ☐ REASON FOR .65 LETTER 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
WELLHEAD PROTECTION AREA: YES ☐ NO ☐ RESPONSIBLE PARTY INFORMATION

OWNER NAME: _____ STREET: _____
CITY: _____ STATE: _____ ZIP: _____
PHONE: (____) _____ CONTACT PERSON: _____

THE TATUSHI TORY

CONFIRMED RELEASE DATE: _____
LUST CLEANUP INITIATED DATE: _____
EMERGENCY RESPONSE TAKEN WITH: STATE ☐ FEDERAL ☐ RP ☐
COMMENTS: _____

IMPACT TO RECEIPIOS
☒ IMPACTED 1. Business ☐ 2. Home ☐ 3. Public _____ ☐ 4. Surface Water _____ ☐ 5. Utilities _____ ☐
Soil ☐ Vapor ☐ Dissolved ☐ Free Product ☐
☐ IMMINENT 1. Business ☐ 2. Home ☐ 3. Public _____ ☐ 4. Surface Water _____ ☐ 5. Utilities _____ ☐
Soil ☐ Vapor ☐ Dissolved ☐ Free Product ☐
☐ POTENTIAL 1. Business ☐ 2. Home ☐ 3. Public _____ ☐ 4. Surface Water _____ ☐ 5. Utilities _____ ☐
Soil ☐ Vapor ☐ Dissolved ☐ Free Product ☐

RELEASE INFORMATION:
Waste Release: ☐ Gasoline ☐ Diesel ☐ Other (specify) _____
Source: ☐ Tank ☐ Piping ☐ Dispenser ☐ Submersible Tankline Pump ☐ Delivery Problem ☐ Other (spec) _____
Cause Information: ☐ Spill ☐ Overfill ☐ Commission ☐ Physical or mechanical damage ☐ Installation problem
☐ Other (specify) _____

ADDITIONAL LEAK/COMPLAINT INFORMATION: _____
ACTION TAKEN: _____

Completed By: _____ Date: _____ Page _____ of _____

LUST Site Visit Report



West Virginia Department of Environmental Protection
Office of Environmental Remediation • 601 57th Street SE • Charleston, WV 25304

Leaking Underground Storage Tank SITE VISIT REPORT

Facility	LEAK #	WV ID #		CLOSURE #
	NAME			PHONE
	ADDRESS	CITY	ZIP	COUNTY
Owner	NAME	CONTACT PERSON	PHONE	
	ADDRESS	CITY	STATE	ZIP
Operator	<input type="radio"/> Owner <input type="radio"/> Other: NAME		PHONE	
	ADDRESS	CITY	STATE	ZIP
Details				
Date:		Arrival Time:	Departure Time:	
Reason for Visit:				
Others Present on Site				
Name	Relation to Site	Company		

Summary

ri!iii!iMMG\$ji!@li!iii!.,

Project Manager's Signature: _____ Date: _____

cc: OERFile

☐ Attachment

LUST Project Status Checklist



West Virginia Department of Environmental Protection
Office of Environmental Remediation

LUST Project Status Checklist

Date

Leak# Leak # Site Name: Site Name
WVID# VVW# Site City and County: City; County
Closure# Responsible Party: Responsible Party
Project Manager: Project Manager

Current Site Conditions			
D Vapors D Free Product D Groundwater Contamination D Soil Contamination			
Update	Release Status	Date	
D	Confirmed Release		
D	Cleanup Initiated		
D	Site Investigation Completed		
D	Site Cleanup Completed		
D	No Further Action (NFA) Issued		
D	Emergency Response		
D	State Lead:	D Referred by Project Manager D Requested by Responsible Party	
D	Risk-Based Remediation:	D Voluntary Remediation Program DUECA	
Update	Correspondence	Requested	Received
D	280.62 Initial Abatement Measures and Site Check Report (20-day)		
D	280.63 Initial Site Characterization Report (45-day)		
D	280.64 Free Product Report (Initial)		
D	280.65 Site Investigation Report		
D	280.66 Corrective Action Plan		
D	Plan Approved		
D	Plan Implemented		
Update	Additional Reports		Most Recent Received
D	Closure Report		

LUST Project Status Checklist

D	Free Product Report
D	Quarterly Monitoring Report
D	Other-

D | Priority Code D1 D2 03
Comments: _____

VRP Site Visit Report



West Virginia Department of Environmental Protection
Office of Environmental Remediation • 601 57th Street SE • Charleston, WV 25304

Voluntary Remediation Program SITE VISIT REPORT

Facility	VRP# PROJECT NAME			
	ADDRESS	CITY	ZIP	COUNTY
Applicant	NAME		CONTACT PERSON	PHONE
	ADDRESS	CITY	STATE	ZIP
LRS	USM	NAME	COMPANY	
	PHONE	EMAIL		

Details		
Date:	Arrival Time:	Departure Time:
Reason for Visit:		
01111rs 1rt'Sl'nl on Sill'		
Name	Relation to Site	Company

Summary

["ii!JIM@iiii!ii!ii!h

Project Manager's Signature: _____ Date: _____

cc: OER File

D AUaunent

VRP Project Status Checklist

VOLUNTARY REMEDIATION PROGRAM PROJECT STATUS CHECKLIST

Site Name:	
Location:	
Project#:	
Owner:	
LRS:	

1. Application is submitted.
Date: (60-3-4)
2. DEP reviews application. ☐ Approved ☐ Disapproved
Date: (45 daytime frame)
3. Applicant submits application fee.
Date: (60-3-4.3)
4. The LRS and DEP Project Manager conduct a site visit.
Date:
5. Applicant executes a Voluntary Remediation Agreement with the DEP.
Date: (60-3-6)
6. The LRS sets up a Public Repository.
Date: (60-3-7.10.b)
7. The DEP publishes a summary of the Application.
Date: (6-3-7.9)
8. The DEP publishes a News Release.
Date: (60-3-7.9.i.1)
9. The LRS has submitted a Site Assessment Work Plan.
Date: (60-3-10)
10. The DEP submits a Cost Estimate to the LRS.
Date: (60 day time frame)

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11. The LRS submits the Site Assessment Report.
Date:
12. The DEP submits a Cost Estimate to review SA Report.
Date: (60 day time frame)
13. The DEP reviews SA Report and responds back to the LRS.
Date: (30 day time frame)
14. The DEP submits a Cost Estimate to LRS for a site visit with the DEP risk assessment contractor, DEP, and the LRS.
Date:
15. The LRS submits a Human Health Risk Assessment (RA).
Date: (60-3-8)
16. The DEP submits a Cost Estimate for review of the RA.
Date:
17. The DEP submits the Human Health RA review response to the LRS.
Date: (30 day time frame)
18. The LRS submits an Ecological RA to the DEP.
Date:
18. The DEP submits a Cost Estimate for review of the Ecological RA.
Date:
20. The DEP submits an Ecological RA review response to the LRS.
Date: (30 day time frame)
21. The LRS submits a Remedial Selection Report.
Date: (60-3-9.8)
22. The DEP submits a cost Estimate.
Date: (60 day time frame)
23. The DEP reviews the Remedial Selection Report and responds to the LRS.
Date: (30 day time frame)
24. The LRS has published a Public Notice of the Remedial Selection.
[Items 24 and 25 only apply to sites that are considering remediation goals where the risk is greater than $JxJ(J^6)$, one in a million, for residential areas or $JxJ(J^5)$, one in one hundred thousand, for industrial areas.]
Date: (60-3-7.12)

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25. The LRS responds to comments and sends a copy of responses to the DEP.
Date: (30 day comment period)
26. Remedial Oversight Period.
Start Date:
27. 111e DEP sends Cost Estimate to LRS for the Oversight Period.
Date: (60 daytime frame)
28. The LRS submits a Residual Risk Assessment.
Date: (60-3-8.6)
29. The DEP submits a Cost Estimate.
Date:
30. The DEP reviews the Residual RA.
Date: (30 day time frame)
31. The LRS submits the Final Report.
Date: (60-3-11)
32. The DEP submits a Cost Estimate.
Date:
33. 111e DEP reviews Final Report.
Date: (30 day time frame)
34. The LRS requests a Certificate of Completion.
Date: (60-3-12)
35. The DEP issues a Certificate of Completion.
Date: (60 day review time frame)

VRP Checklist for Risk Assessment Review

CHECKLIST FOR RISK ASSESSMENT REVIEW			
Name of site in ERIS			
Street Address	City	County	ZIP
Title of Document			
Date received by OER	Due Date of Response		
DEP Project Manager	Phone Number/Extension		
LRS	Phone	Email	
Risk Assessor	Phone	Email	
If draft of this document has been previously reviewed, please indicate:			
Date of prior review	Reviewer		
Date of prior review	Reviewer		
Date of prior review	Reviewer		
Site Assessment:	Yes	No	Comments or Concerns
Is the site accurately described?			
1. Physical setting			
2. Notable geologic and hydrogeologic features			
3. Historical, current and future use of site			
4. Current and future land use adjacent to site			
5. Surrounding areas of ecological significance			
Is the site assessment complete?			
1. Potentially impacted media			
2. Potential source areas			
3. Potential offsite migration			
4. Use of appropriate analytical methods			
5. Field screening tools used appropriately			
Do data accurately represent site conditions?			
1. All relevant data presented and discussed			
2. Detection limits are at appropriate levels			
3. Sufficient samples have been collected			
4. Data quality objectives consistent with use			
5. Data validation performed as required			
Exposure Assessment	Yes	No	Comments or Concerns
Has a Site Conceptual Model been submitted?			
1. All potential onsite receptors considered			
2. Offsite receptors included if necessary			
3. Future exposures consistent with land use			
4. Ecological receptors are addressed			
Are exposure point concentrations appropriate?			
1. Appropriate statistical analysis of site data			
2. Estimate based on fate and transport models			
Have all site contaminants been addressed?			
1. Compliance with de minimis standards			
2. Compliance with uniform risk based standard			
3. Compliance demonstrated by risk assessment			
4. Site contaminants below background			
Is Ecological Checklist completed correctly?			
1. Meet relevant ecological benchmarks			
Are institutional/engineering controls required?			
1. Deed restrictions or covenants			
2. Operation and maintenance agreements			
3. Health and safety plan			
Do you agree with the conclusions as presented?			
Additional comments:			
Date sent for risk assessment review		Requested completion date	
Date received for review		Review completion date	